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Note to Stakeholders:

This is a Preliminary Draft (some appendices and text are still being developed) of the Original Landfill IM/IRA and is not intended to be a draft for written comment.

This Preliminary Draft is to keep you informed as to the status of the Original Landfill Accelerated Action Process.

An Informal Draft IM/IRA will be submitted to you at a later date for comment prior to public comment You will also have another opportunity to comment during the 45-day public comment period.

Please contact Bob Birk/DOE Project Manager (bob.birk@rf.doe.gov) at 303-966-5219 or Bob Davis/K-H (robert.davis2@rfets.gov) at 303-966-7026 if you have any preliminary thoughts or comments on this document.

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DRAFT INTERIM MEASURE/INTERIM REMEDIAL ACTION FOR THE ORIGINAL LANDFILL (INCLUDING IHSS GROUP SW-2; IHSS 115 AND IHSS 196, FILTER BACKWASH POND)

February 2004

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APPENDICES AND ATTACHMENTS

ACRONYMS & ABBREVIATIONS

AL	action level
Am	americium
APEN	Air Pollutant Emission Notice
AR	Administrative Record
ARARs	Applicable or Relevant and Appropriate Requirements
bgs	below ground surface
CAD/ROD	Corrective Action Decision/Record of Decision
CCR	Colorado Code of Regulations
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
cfs	cubic feet per second
CFR	Code of Federal Regulations
CID	Cumulative Impact Document
COC	contaminant of concern
DOE	U S Department of Energy
DU	depleted uranium
EPA	U S Environmental Protection Agency
FIDLER	Field Instrument for the Detection of Low Energy Radiation
HRR	Historical Release Report
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
Kg	kilogram
K-H	Kaiser-Hill Company, L L C
MOU	Memorandum of Understanding
NEPA	National Environmental Policy Act
NOI	Notification of Intent
NPDES	National Pollutant Discharge Elimination System

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ACRONYMS & ABBREVIATIONS

OLF	Original Landfill
OU	Operable Unit
PAC	Potential Area of Concern
PAH	Polynuclear Aromatic Hydrocarbon
PCB	polychlorinated biphenyl
pCi/L	picocuries per liter
PCOC	potential contaminant of concern
PMJM	Preble's Meadow Jumping Mouse
Pu	plutonium
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation/Remedial Investigation
SID	South Interceptor Ditch
Sr	strontium
SWD	Soil Water Database
U	uranium
USFWS	U S Fish & Wildlife Service
USHU	Upper Hydrostratigraphic Unit
WRW	Wildlife Refuge Worker

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EXECUTIVE SUMMARY

This section is to be provided after final review

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1.0 INTRODUCTION

Thıs Interım Measure/Interım Remedıal Actıon (IM/IRA) Decısıon Document presents the proposed accelerated actıon to remedıate the Indıvıdual Hazardous Substance Sıte (IHSS) Group SW-2 at the Rocky Flats Envıronmental Technology Sıte (RFETS) IHSS Group SW-2 consısts of two IHSSs IHSS 115, the Orıgınal Landfill, and IHSS 196, the Fılter Backwash Pond

RFETS ıs a Comprehensıve Envıronmental Response, Compensatıon and Lıabılıty Act (CERCLA) Natıonal Prıorıty Lısted (NPL) Sıte and ıs located ın rural northern Jefferson County, Colorado approxımately 16 mıles northwest of Denver It ıs approxımately 6,550 acres ın area The developed portıon of the sıte, referred to as the Industrıal Area, ıs centrally located wıthın RFETS and occupıes approxımately 400 acres The Rocky Flats Buffer Zone surrounds the Industrıal Area and occupıes the remaınıng 6,150 acres IHSS Group SW-2 ıs located ın the southern part of the Industrıal Area Operable Unıt (OU) and adjacent to the Buffer Zone OU See Fıgures1-1 and 1-2

The Rocky Flats Cleanup Agreement (RFCA) (DOE et al 1996) ıs a CERCLA federal facılıty cleanup agreement and a complıance order on consent under the Resource Conservatıon and Recovery Act (RCRA) and the Colorado Hazardous Waste Act between the Department of Energy (DOE), the Envıronmental Protectıon Agency, Regıon VIII (EPA) and the Colorado Department of Publıc Health and Envıronment (CDPHE) RFCA provıdes the regulatory framework for cleanup of hazardous substances at the Sıte In accordance wıth RFCA, thıs IM/IRA ıs subject to CDPHE and EPA and publıc revıew and comment and approval by CDPHE, the Lead Regulatory Agency for RFCA accelerated actıons ın the Industrıal Area OU

Thıs IM/IRA descrıbes the nature and extent of contamınatıon for IHSS Group SW-2, compares the data to RFCA actıon levels, presents and evaluates accelerated actıon alternatıves and descrıbes the proposed actıons Actıons undertaken to ımplement the approved accelerated actıon wıll be documented ın a closeout report

1.1 Need for RFCA Accelerated Action

Between 1952 and 1968 approximately 74,000 cubic yards of solid waste consisting of construction and other debris and general plant waste contaminated with or commingled with small amounts of wastes with hazardous constituents were disposed in the approximately 20 acre Original Landfill, IHSS-115 The Original Landfill (OLF) is located on the south-facing slope just south of the Industrial Area pediment and borders the north side of Woman Creek Because of the slope angle and underlying bedrock characteristics, this area has been identified as susceptible to landslides and erosion

From the early 1950s until 1971 filter backwash waste water generated by the raw water treatment process in Building 124 to make potable water was discharged to settling and evaporation ponds located roughly in the center of IHSS-115, designated the Filter Backwash Pond, IHSS-196 A soil cover was placed over the disposed waste when the OLF was closed in 1968 Some of the wastes and debris have become exposed through erosion of the soil cover on the wastes that were placed at steep slopes Besides the soil cover, soil fill material was used in the waste disposal operation The volume of disposed waste and commingled soil is estimated at 160,000 cubic yards

The IHSSs 115 and 196 were formerly part of Operable Unit 5 (OU-5), the Woman Creek Priority Drainage, which was consolidated into the Industrial Area OU when the RFCA became effective in July 1996 Prior to this consolidation a Phase 1 RCRA Facility Investigation/Remedial Investigation (RFI/RI) for OU-5 was conducted pursuant to an RFI/RI Work Plan, which was approved by CDPHE and EPA in 1992 (EPA 1992a, 1992b, CDPHE 1992) For purposes of the investigation work the OU-5 IHSSs (and Potential Areas of Concern [PACs]) were separated into specific areas of concern The IHSSs 115 and 196 were designated Area of Concern 1

One of the purposes of the OU-5 Phase 1 RFI/RI work for the OLF was to gather sufficient geotechnical information to evaluate landslide mechanisms in the OLF The OU-5 Phase 1 RFI/RI work also included source and environmental media characterization for the OLF and a human health and ecological risk assessment for Area 1 The OU-5 Phase 1 RFI/RI Report was completed in 1996 (Kaiser-Hill 1996)

Section 2 0, Site Background, Section 3 0, Environmental Setting, and Section 4 0, Nature and Extent of Contamination, provide detailed information about the Original Landfill and Filter Backwash Pond history and the OU-5 Phase 1 RFI/RI

In addition to the problems posed by inadequate soil cover, which allows possible direct contact to the disposed wastes, soil, surface water and ground water sampling and analysis shows some contamination above background levels Some organic compounds and metals (including depleted uranium) contamination is present at levels greater than action levels and/or standards applicable to these media contained in the *Action Levels and Standards Framework for Surface Water, Ground Water and Soils*, RFCA Attachment 5 (ALF) Pursuant to RFCA, if ALF action levels or standards are exceeded, an evaluation, remedial action and/or management action is triggered.

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DOE proposes to conduct a remedial action for the OLF and Filter Backwash Pond Pursuant to RFCA, remedial actions taken for one or more IHSSs shall be conducted as a RFCA accelerated action Because this accelerated action is estimated to take longer than six months from the time of commencement of physical work to complete, RFCA requires that the work shall be conducted pursuant to an IM/IRA Section 11 0, Implementation Schedule, provides an informational schedule for the major work activities, which are expected to take about 9 months to complete

1.2 Proposed Accelerated Action – The Municipal Landfill Presumptive Remedy

EPA has published two directives regarding the application of the "source containment" presumptive remedy to municipal and military landfills (EPA 1993, EPA 1996)

> *"Presumptive remedies are preferred technologies for common categories of sites based on historical patterns of remedy selection and EPA's scientific and engineering evaluation of performance data on technology implementation By streamlining site investigation and accelerating the remedy selection process, presumptive remedies are expected to ensure consistent selection of remedial actions to reduce the cost and time required to clean up similar sites Presumptive remedies are expected to be used at all appropriate sites Site-specific circumstances dictate whether a presumptive remedy is appropriate at a given site "*

Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills, OSWER Directive No 9355 0-67FS, December 1996, p 1 The directive recognizes that military landfills may contain waste types that are different from those found in municipal landfills but that pose a hazard profile similar to that of municipal landfills The directive provides criteria for evaluating whether the landfill contents have characteristics similar to municipal landfill contents If the characteristics are similar then the presumptive remedy should be considered and implemented if appropriate While the OLF is not on a military base, because of its size and waste types, it is similar to military landfills at other NPL Sites where the presumptive remedy has been implemented

EPA has also published several directives regarding conducting and streamlining the Remedial Investigations/Feasibility Studies at CERCLA municipal landfill sites (EPA 1991, EPA 1994) The presumptive remedy process involves using existing data to the extent possible and limiting the characterization of the landfill contents, conducting a streamlined risk assessment and developing a focused feasibility study to analyze only the alternatives consisting of appropriate components of the presumptive remedy

The OU-5 Phase 1 RFI/RI Report and ground water and surface water monitoring provide sufficient information to evaluate the OLF in accordance with the military and municipal landfill presumptive remedy guidance Section 5 0, Remedial Objectives, provides a discussion of the evaluation for the determination that the "source containment" remedy is appropriate Section 6 0, Remedial Action Alternatives Evaluation, and Section 7 0, Proposed Remedial Action Plan, provide details regarding

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the components of the proposed source containment remedy Section 6 0 also evaluates the "no action" and removal alternatives

Section 8.0, Applicable or Relevant and Appropriate Requirements (ARARs), along with Appendix A provide a discussion of the regulations pertaining to this accelerated action Section 9 0, Environmental Impacts, provides a discussion and analysis of the environmental consequences associated with the proposed action Section 10 0, Additional Long-Term Stewardship Considerations, identifies additional post-closure activities to be implemented for this accelerated action

Section 13 0, Administrative Record, identifies the documents considered by DOE, CDPHE and EPA in proposing this accelerated action, which are available for public review at the Rocky Flats Reading Room

2.0 SITE BACKGROUND

2.1 IHSS Group SW-2 Site Description

The IHSS Group SW-2 site covers approximately 20 acres and includes two IHSSs IHSS 115, the Original Landfill, and IHSS 196, the Filter Backwash Pond IHSS 115 is located south of the RFETS Industrial Area pediment on a south-facing hill slope north of Woman Creek IHSS 196 lies approximately in the center of IHSS 115 Approximately 1,000 feet of the South Interceptor Ditch (SID), storm drain and building footer drain discharge pipes and other disturbed areas lie within IHSS 115 (See Figure 2-1) These IHSSs were formerly part of Operable Unit 5 (OU-5), Woman Creek Priority Drainage An OU-5 Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (OU-5 Phase 1 RFI/RI) was conducted in accordance with an approved work plan, and a final report was issued April 1996 (Kaiser-Hill 1996)

2.2 Description and History of IHSS 115 (Original Landfill)

The OLF was used to dispose solid sanitary and construction debris wastes generated at the Rocky Flats Plant from 1952 to 1968 (Rockwell 1988) The landfill was not designed or operated as an engineered landfill Aerial photographs indicate that the landfill was operated as an area fill (EG&G 1994) Waste was merely dumped in the area vertically below and just south of the southern edge of the alluvial pediment on which the RFETS Industrial Area is located The waste disposal area lies north of Woman Creek The waste was generally spread over the south-facing hillside, serving to fill in the area below the pediment edge No liner or other collection barrier was installed between the waste and the existing surfaces, which means that precipitation and groundwater passing through the waste is not prevented from migrating into surrounding and underlying soil and groundwater In the waste placement process, the waste material was mixed with native soil materials. The volume of disposed waste and commingled soil is estimated at 160,000 cubic yards. Because of the slope angle and the colluvial material making up the hill side, the hillside in this area has been identified as susceptible to erosion and sliding, before the slope was covered with waste fill (Metcalf & Eddy 1995)

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Disposal operations at the OLF probably ceased by the fall of 1968 because the Present Landfill (IHSS 114, located north of the Industrial Area) began operation on August 17, 1968 (EG&G 1992) The waste material was covered with a soil layer after the disposal operations ceased (EG&G 1994) Details on the placement of the soil cover layer, including exactly when it was constructed, are not available Portions of the slope on the south side of the landfill were later re-graded to correct sloughing and erosion problems Accurate and verifiable records of the wastes placed in the landfill are not available However, approximately 74,000 cubic yards of sanitary waste and construction debris were disposed in the landfill (Kaiser-Hill 1996) These types of wastes likely included relatively small quantities of organics, paint and paint thinner, oil, pesticides, and cleaners (Rockwell 1988) Commonly used organics from 1952 to 1968 may have included trichloroethene, carbon tetrachloride, tetrachloroethene, petroleum distillates, 1,1,1-trichloroethane, dichloromethane, and benzene (Kaiser-Hill 1996) In the 1960s, the landfill may have received PCB wastes (DOE 1992), such as carbonless copy paper, transformer and vacuum pump clean-up paper and rags, and small capacitors and fluorescent light bulbs Metals such as beryllium, lead and chromium may also have been placed in the landfill (Rockwell 1988)

There is no information indicating that the OLF was used for routine disposal of radioactive material and other hazardous substance waste streams During the period of operation of the Original Landfill, several other areas within RFETS were used for the management and disposal of hazardous plant wastes, including radioactive waste For example, some uranium wastes were buried in the east trenches and drums with cutting oils and solvents were stored at the 903 Pad These areas are described in the Historical Release Report (EG&G, 1992a) and subsequent annual updates The majority of radioactive solid waste generated on site was disposed off site Various controls and practices were used to segregate and manage radioactive wastes separately from plant sanitary waste and construction debris While the OLF was not operated for management or disposal of radioactive waste, the information in the Historical Release Report and characterization results indicate that some waste contaminated with radioactive material, most notably wastes from buildings where depleted uranium (DU) operations were conducted were disposed in the Original Landfill In addition, in 1965, 60 kg of DU was placed in the landfill after the DU, which was left on a pallet reportedly had ignited on a truck flatbed The DU was probably covered with soil to extinguish the fire Efforts were later made to retrieve the DU, however, only 40 kg was recovered Further use of the affected area of the landfill was avoided (EG&G 1992a, DOE 1992) No record of any similar incident was found and workers have reported none

Activities listed for the landfill in October 1954 included its use as a burning pit for the plant (EG&G 1992a) Ash from the plant incinerator, graphite, used caustic drums, and general trash may have been dumped in the burn pit, but no records of waste types have been found Incinerator ash, for at least the first decade of plant operation, included ash derived from the incineration of combustible paper and other trash contaminated with low levels of DU surface contamination from Building 444, in addition to other combustible plant wastes (EG&G 1992a) Although some incinerator ash may have been disposed in the Original Landfill, the ash was routinely disposed of in several pits west of the Original Landfill, IHSS-133, Incinerator Ash Pits Based on investigation and

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characterization of the Incinerator Ash Pits, a RFCA No Further Accelerated Action was approved (EPA, 2003) Backwash water discharged from the water treatment plant passed through a drainage channel on the west side of the burn pit, and flowed down to Woman Creek No information is available identifying the period of operation for the burning pit

In 1995, Metcalf and Eddy conducted geotechnical investigations at the OLF as part of the OU-5 Phase 1 RFI/RI work and described the fill material encountered during the investigation The material consisted of waste materials mixed in varying amounts with sandy, clayey gravel and cobbles derived from colluvium and Rocky Flats Alluvium The waste materials in the fill included sheet metal, wood, broken glass, plastic, rubber, metal shavings, graphite sand, solid blocks of graphite, concrete, asphalt, and portions of 55-gallon steel drums The waste fill ranged in thickness from 2 feet to over 11 feet

Seepage emerging from the OLF after a major rainstorm in July 1986 was traced to an outfall pipe from the Building 460 footing drains (EG&G 1992) Sloughing of material in the area of the outfall occurred as a result and the hillside materials may have been washed into the South Interceptor Ditch (SID) To prevent migration of materials, a containment embankment was constructed to prevent flow into Woman Creek (EG&G 1992) The outfall piping was also extended to the east to discharge beyond the landfill boundary (refer to Section 2 4)

Street cleaning wastes were apparently dumped at the OLF area The duration of use of this area for street cleaning wastes is not known In March 1991 EPA requested that the dumping cease as it may exacerbate any ground water and soil contamination and it was inconsistent with the planned CERCLA response (EPA 1991) In July 1991 the contractor notified DOE that it had instructed the appropriate departments not to use the Landfill as a dumping site for street sweeping litter and concrete truck washout (EG&G 1991)

2.3 Description and History of IHSS 196 (Filter Backwash Pond)

The water treatment plant Filter Backwash Pond was located on the hillside north of Woman Creek, approximately 800 feet south of the water supply treatment plant in Building 124 (EG&G 1992) The treatment plant treats water that is delivered from the Denver Water Board reservoir and ditch system to the raw water pond located north of the west access road to produce plant potable water The Filter Backwash Pond, also known as Pond 6, was used as a retention pond to allow sampling of filter backwash water It was also described as an evaporation and settling pond (EG&G 1992) There is no record of sludge or sediment removal from the pond (DOE 1992)

Pond 6 was constructed in 1955 However, water from the water treatment plant was discharged at the OLF before the pond was constructed. The Historical Release Report (EG&G 1992) refers to an October 1954 reference that indicates that backwash water from the water treatment plant flowed through the west side of the plant burning pit and down to Woman Creek. It is possible that Pond 6 was constructed in the location of the plant burning pit (EG&G 1992) It is unclear when the Filter Backwash Pond was

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abandoned By 1964, Pond 6 was no longer present, and the area was covered with fill (Kaiser-Hill 1996)

The effluent from the water treatment plant was discontinuous and was probably made up of filter backwash, filter pre-wash, sludge blowdown, and other discharges from the water treatment process (EG&G 1992) It contained the filterable solids removed from the raw water, as well as chemical flocculants (aluminum sulfate or lime) and residual chlorine (EG&G 1992)

2.4 Other Disturbances and Structures

Other disturbances and structures associated with IHSS Group SW-2 include a small surface disturbance located west of the landfill waste disposal area, a larger surface disturbance located east of the landfill area, the SID, and two outfall pipes and their associated surface disturbances An area of suspected surface disturbance and a possible pit were identified west of the landfill from a review of aerial photography (EG&G 1994) No historical information identified activities in the area (See Figure 2-1)

The surface disturbance area east of the landfill waste disposal area was also identified from review of aerial photography for the OLF site (EG&G 1994) The area was active in the 1964 photography Little historical information is available for this area, however, the area may have served as a storage yard for pipes and scrap metal (EG&G 1994) In 1969 and 1971 aerial photography, the area contains mounds of debris (EG&G 1994)

In 1980, the SID was built across the southern portion of the landfill (EG&G 1994) The purpose of the SID was to intercept runoff from the southern portions of the Rocky Flats Plant and divert the flow to Pond C-2 Two outfall pipes cross the OLF site The original outfall pipe, constructed in 1986 (EG&G 1994), discharged storm water directly onto the landfill This caused sloughing and sliding of the fill material Slide material may have been removed from the SID and placed on the south side of the gravel road constructed south of the SID (Metcalf & Eddy 1995) Sometime between 1986 and 1988, the original outfall pipe was abandoned and a new outfall pipe constructed southeast across the OLF to discharge to the SID east of the landfill boundary The buried outfall pipe discharges into a collection basin located east of the Original Landfill Landsliding and construction of the outfall pipes may have exposed landfill waste at the surface

2.5 Historical Interim Response Actions

Three separate response actions have been undertaken at the Original Landfill On July 23, 1979, contractors grading a road southwest of Building 444 outside the perimeter fence uncovered a portion of the landfill (EG&G 1992) The area was surveyed, and three locations of depleted uranium were identified One box of contaminated soil was removed (EG&G 1992)

The reach of Woman Creek adjacent to the western portion of the landfill was relocated because the creek threatened to erode into landfill materials (Singer, 2002). Specific information on the relocation of Woman Creek, including when the creek was relocated, is not available

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On June 7, 1990 EPA, CDPHE and DOE staff conducted an inspection to evaluate previously identified exposed radioactive debris in the northwestern part of the OLF (EPA 1990) It is not known exactly when the debris became exposed, but the area apparently was identified in April, 1990 as a barrel containing radioactive materials (DOE 1990) A radioactive materials survey near the barrel discovered low levels of depleted uranium (EG&G 1990a) The area was roped off and access restricted, soil and water samples taken and a requested radiological survey of the entire OLF Area was subsequently conducted (EG&G 1990b) A gamma radiation survey conducted in late 1990 identified ten locations of elevated gamma radiation (Kaiser-Hill 1996)

A radiological survey with a Field Instrument for the Detection of Low Energy Radiation (FIDLER) was also conducted at the OLF in 1993 as part of the OU-5 Phase 1 RFI/RI work (EG&G1994) Of the ten areas identified in 1990, the FIDLER survey did not identify any anomalous levels of radiation at seven of the locations Within the bounds of two areas in the center of the OLF identified by the 1990 survey, nine areas of anomalous levels of radiation were found These areas were posted as Radiologically Controlled Areas Several pieces of radioactive material were removed from these areas on May 28, 1993 during an emergency removal action The material removed included a 4- to 6-inch diameter piece of concrete coated with a corroded metallic material, and several small (1- to 2-inch diameter) spherical pieces of rusty material The materials were removed for subsequent management as radioactive material (EG&G 1994) Analyses indicated that the materials contained depleted uranium In those areas where a specific source of the anomalous radioactivity could not be identified, surface soil samples were collected

Annual walkdowns of the landfill surface have been done each spring to search for classified items since 2000 No classified items have been found, however, several carbon molds have been removed from the area and appropriately dispositioned Some of the items have exhibited very low levels of depleted uranium activity

2.6 Slope Stability

Landslides have historically occurred at the OLF site During the 1995 geotechnical study, historic areas of discrete landslides were identified, as well as general areas of sliding (Kaiser-Hill 1996) In addition, the geotechnical study identified three potential slope failure mechanisms operating in the OLF area These mechanisms are

- Shallow landslides consisting of waste fill sliding on severely weathered claystone (near surface aspect of the upper member of the Laramie Formation),
- Shallow landslides consisting of colluvium sliding on or with severely weathered claystone, and
- Deeper landslides consisting of movement within moderately weathered claystone at depths up to or about 35 feet, especially in areas of steeper slopes

The landslides on the claystone bedrock slopes below the alluvial surface probably commenced after the slopes were initially exposed by continued stream erosion through

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the pedıment, renderıng the overlyıng materıals unstable and predısposıng them toward movement Aerıal photographs of the Woman Creek draınage prıor to the waste dısposal support thıs theory by ındıcatıng that some landslıdes occurred prıor to fill deposıtıon

2.7 Existing Conditions

It has been approxımately 35 years sınce dısposal operatıons ceased at the OLF The area now has well-establıshed grasses and forbs, several stands of large trees and several small areas of wetland vegetatıon Most of the waste ıs currently covered by soıl up to several feet thıck, however, the surface of the area ıs hummocky, and some dısposed materıals are protrudıng from the ground ın some areas Thıs ındıcates uneven waste and cover soıl layer placement resultıng ın erosıon and sloughıng processes that uncover the wastes The thıckness and the final gradıng and cover soıl layer appears to be ınadequate ın a few places There ıs no ındıcatıon of landslıdıng or mass movement of the waste and soıl fill There are no seeps ın the area Several radıoactıve contamınatıon "hot spots" have been ıdentıfied vıa surface soıl samplıng (refer to Sectıon 4 1)

3.0 ENVIRONMENTAL SETTING

3.1 Physiography

RFETS ıs located on the western margın of the Colorado Pıedmont sectıon of the Great Plaıns Physıographıc Provınce at an elevatıon of approxımately 6,000 feet (Kaıser-Hıll 1996) The Colorado Pıedmont ıs characterızed as an area of dıssected and denuded topography, representıng an old erosion surface along the eastern margın of the Rocky Mountaıns Several pedıments (broad slopıng planes formed by coalescıng alluvıal fans along a mountaın front) developed across bedrock ın the RFETS area durıng the Quaternary Perıod (Scott 1963) The Rocky Flats pedıment ıs the most extensıve of these pedıments

The RFETS ındustrıal area ıs located on a relatıvely flat surface of the Rocky Flats pedıment The pedıment surface has been eroded by Walnut Creek on the north and Woman Creek on the south As a result, the pedıment surface ıs located at an elevatıon of 50 feet to 150 feet above the creeks The grade of the gently eastward-slopıng surface of the Rocky Flats pedıment ranges from one percent ın the ındustrial area of RFETS to approxımately two percent just east of the ındustrıal area. Further east, the pedıment's nearly flat-lyıng surface gives way to lower gently rolling terraın of the Hıgh Plaıns sectıon of the Great Plaıns Physıographıc Provınce (Kaıser-Hıll 1996)

Four ephemeral creeks draın the surface water from RFETS The surface water that flows from the northern portıon of RFETS ıs drained by Rock Creek, which is a northeast-trendıng trıbutary of Coal Creek. The central and southern portıons of the sıte are draıned by Walnut Creek, South Walnut Creek, and Woman Creek These draınages are all trıbutarıes of Bıg Dry Creek that flows eastward Coal Creek separates all of the streams on the Rocky Flats pedıment from the Front Range foothills Surface water flow in these creeks ıs generally ephemeral, however, some reaches may support ıntermıttent or perennıal flow

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3.2 Climate

The climate at RFETS is characterized as semi-arid (Kaiser-Hill 1996) with a mean annual precipitation of approximately 15 5 inches, based on 20-year means for Boulder and Lakewood, Colorado The wettest season is spring (March through May), which accounts for approximately 40 percent of the annual precipitation, much of which is snow Thunderstorms during the summer months provide another 30 percent of the annual precipitation The precipitation gradually declines through the summer, fall and winter (Kaiser-Hill 1996) Average annual pan evaporation in central Colorado is approximately 55 inches (DBS 2001)

The predominant wind direction at RFETS is northwesterly, and average wind speeds are under 15 miles per hour Daytime heating causes upslope winds to form, with northeasterly winds common over the broad South Platte River Valley More localized southeasterly winds also occasionally occur during the day at the site because the terrain is oriented southeast toward Standley Lake and the City of Arvada The winds reverse at night with a shallow westerly drainage wind forming over the site and a broad southerly drainage wind forming over the South Platte River Valley (DOE 1999)

RFETS is noted for its strong winds Gusty winds frequently occur with thunderstorms and the passage of weather fronts The highest wind speeds occur during the winter as westerly windstorms, known as Chinooks The windstorm season at the site extends from late November into April, with the height of the season usually occurring in January The windstorms typically last 8 to 16 hours, with wind speeds exceeding 75 miles per hour in almost every season Wind gusts exceeding 100 miles per hour are experienced every three to four years (DOE 1999)

3.3 Geology

Geologic units beneath the OLF consist of unconsolidated Quaternary deposits that lie unconformably over Cretaceous claystone bedrock Six north-south cross sections were developed during the 1995 geotechnical study One cross section is shown in Figure 3-1 and is typical of the other cross sections developed in the study (EG&G, 1995, Kaiser-Hill, 1996) The unconsolidated surface deposits include the Rocky Flats Alluvium that dominates the surface of RFETS, colluvial materials that form the slopes of the Woman Creek valley, and valley fill materials on the bottom of Woman Creek valley These materials overlie the Laramie Formation bedrock (Metcalf & Eddy 1995) Geologic units in the OLF area are described below

3.3.1 Rocky Flats Alluvium

The Rocky Flats Alluvium was deposited by a system of coalescing alluvial fans aggraded by debris flows and braided streams along the base of the Front Range at the mouth of Coal Creek Canyon (EG&G 1995) The alluvial deposits generally consist of beds and lenses of poorly sorted, clast- and matrix-supported, white to pink, sandy cobbly gravel, gravelly sand, and silty sand (Kaiser-Hill 1996) The thickness of this unit ranges from about 3 feet to 30 feet in the areas where the pediment deposits overlie Cretaceous-aged bedrock (Kaiser-Hill 1996)

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3.3.2 Colluvial Deposits

Colluvial deposits along the valley slopes at RFETS are middle Pleistocene to Recent in age (Kaiser-Hill 1996) The colluvial material commonly consists of dark-gray to light-reddish-brown, silty sand, sandy silt, clayey silt, and silty clay that contains minor amounts of boulders and cobbles The unit locally includes clast- and matrix-supported boulders and cobbles, and coarse to fine gravel in a silty-clay matrix These materials are well graded to poorly graded and unstratified to poorly stratified Clasts are typically subangular to subrounded, and their sedimentological composition reflects that of the bedrock and surface deposits from which they were derived The thickness of the colluvial deposits ranges from 3 to 15 feet

In the OLF area the unconsolidated colluvial deposits consist of sandy, clayey gravel (derived from the adjacent Rocky Flats Alluvium) to sandy clay (Metcalf & Eddy 1995) The colluvium is frequently mixed with fill material in the landfill Soil borings indicate that the thickness of the colluvium ranges from 1 to 13 feet The colluvium is damp to moist, although it can be wet near its contact with the Laramie Formation (Metcalf & Eddy 1995)

3.3.3 Valley-fill Alluvium

Valley-fill alluvium, located along the Woman Creek drainage, includes channel and terrace deposits related to the modern stream These Recent alluvial deposits are commonly grayish-brown, slightly cobbly, silty sand to sandy, clayey silt in the upper part, and poorly sorted, clast supported, slightly cobbly, gravel in a light yellowish brown, clayey, silty sand matrix in the lower part (Kaiser-Hill 1996) Clasts are mostly subangular quartzite, with a minor amount of subrounded sandstone derived from older Quaternary deposits The thickness of these deposits ranges from approximately 3 to 15 feet, with an average of about 10 feet

During geotechnical investigations at the OLF (Metcalf & Eddy 1995), valley fill alluvium was encountered in three boreholes along the toe of the landfill The alluvium consisted of medium dense to dense, sandy, silty, clayey gravel with cobbles The alluvium ranged from 5 to 7 feet thick, and groundwater was encountered as shallow as two feet below ground surface (bgs)

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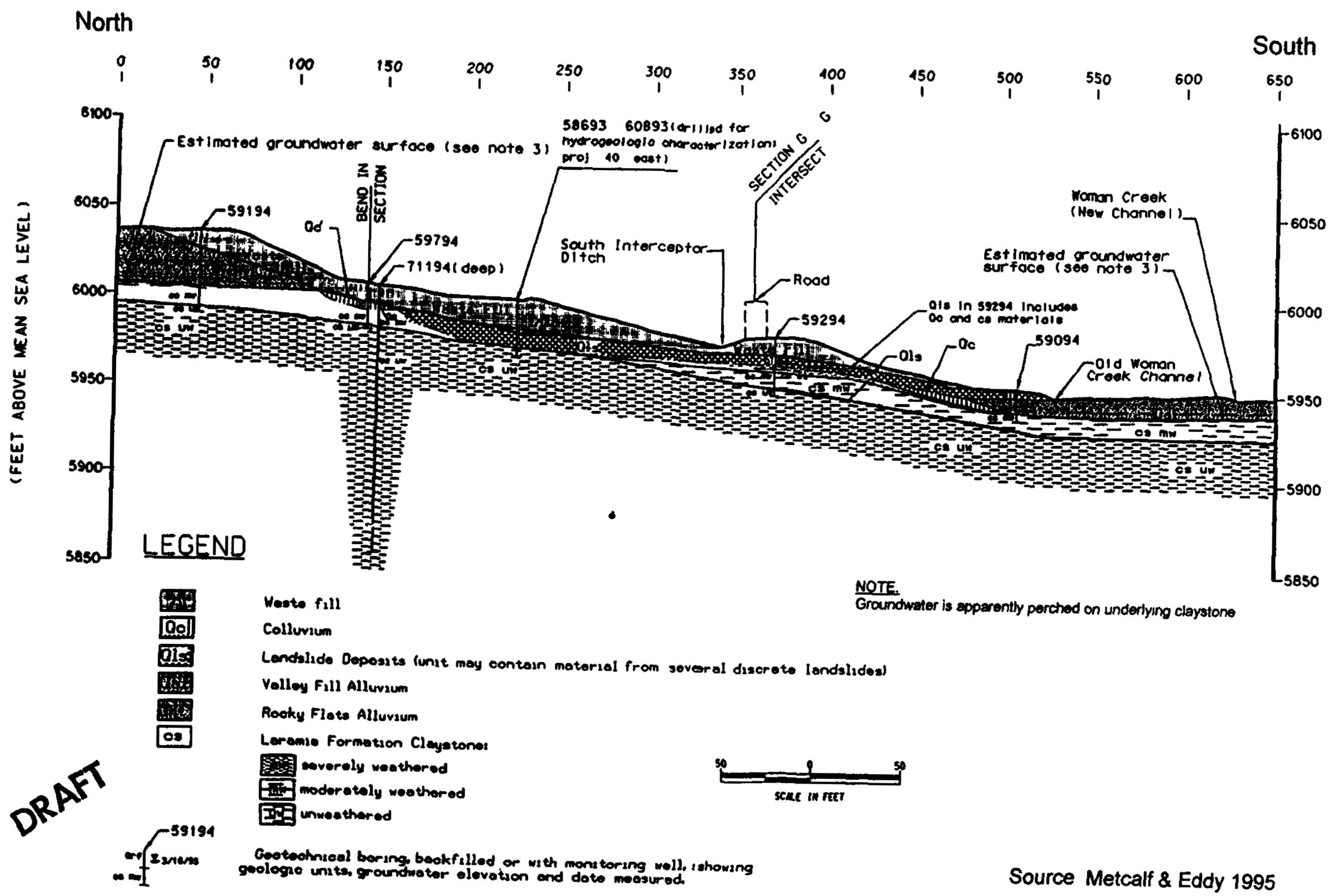
Figure 3-1 Geological Cross-Section of the Original Landfill



Source Metcalf & Eddy 1995

3.3.4 Laramie Formation

Bedrock in the OLF area is Laramie Formation (Kaiser-Hill 1996) The Cretaceous-aged Laramie Formation is approximately 600 feet to 800 feet thick It has been informally divided into upper and lower members (Kaiser-Hill 1996) The upper Laramie Formation is generally distinguished from the lower Laramie Formation where the upper Laramie Formation is dominantly composed of fine-grained sedimentary rocks (primarily claystone with no thick sandstone beds) The upper part of the upper Laramie Formation is approximately 300 feet to 500 feet thick, and consists primarily of olive-gray to yellowish orange claystone with large ironstone nodules A few thin, discontinuous coal seams occur in the upper Laramie Formation Lenticular beds of platey laminated or friable, calcareous, fine-grained, light olive-gray sandstone occur in the upper Laramie Formation, particularly in the upper portions of the formation

In the OLF area, the Laramie Formation is a weak claystone formation that underlies the soil-bearing slopes in the area of the OLF (Metcalf & Eddy 1995) It is severely weathered (soft, plastic and moist) in its near-surface aspect and underlies surficial materials in over 50 percent of borings Moderately weathered Laramie Formation underlies the severely weathered Laramie Formation and is locally plastic, soft, damp, and fractured It was encountered underlying surficial material in approximately 35 percent of the borings, indicating that the severely eroded Laramie Formation was sometimes displaced through sliding or erosion Unweathered Laramie is the deepest component of the upper member and is similar to the moderately weathered Laramie Formation, although somewhat drier (Metcalf & Eddy 1995)

3.3.5 Inferred Faulting

Several inferred faults had been identified during site-wide geological investigations at RFETS (EG&G 1995) The longest of these is a northeast-trending reverse fault that extends from Woman Creek to Colorado Highway 128 across the western part of the Industrial Area The fault plane is assumed to dip to the west A borehole drilled into this fault, or fault zone, in another portion of RFETS filled with water within a few hours of drilling (EG&G 1995) The Geological Characterization Report (EG&G 1995, Figure 7-6) shows the fault trace going through the west side of the Original Landfill

The geotechnical investigation of the OLF (Metcalf & Eddy 1995) considered the presence of the fault Metcalf & Eddy (1995) identified the bedrock fault as trending southwest from the vicinity of Building 371 through the OLF between borings 59794/71194 and 57194 The general location of the fault is shown on Figure 3-2 The location identified by Metcalf & Eddy (1995) and in the Final OU 5 RFI/RI Report (Kaiser-Hill 1996) goes through the center of the landfill This location is based on the Systematic Evaluation Program (Geomatrix 1995) An evaluation of inferred faults in the vicinity concluded that this fault was not capable of generating future earthquakes (Geomatrix 1995) The fault is not expected to disrupt the engineering features or impact the structural integrity for the landfill

3.4 Groundwater

The uppermost groundwater is the shallow, unconfined groundwater that occurs within the Rocky Flats Alluvium, colluvial deposits, valley fill alluvium, and the weathered Laramie Formation This water bearing zone is also referred to as the Uppermost Hydrostratigraphic Unit (UHSU) (EG&G, 1995b) The UHSU is not an "aquifer" because it is not capable of yielding significant and useable quantities of groundwater to wells or springs (EG&G, 1995b) Soil borings in the Rocky Flats alluvium indicate that groundwater is perched on top of claystone at the alluvium/bedrock contact The groundwater saturated thickness ranges from 3 to 8 feet above the contact (Metcalf & Eddy 1995) The shallow groundwater on the east side of the industrial area flows generally eastward toward Woman Creek

Groundwater in the Rocky Flats Alluvium generally flows eastward, except along the margins of the pediment where groundwater flow is toward the drainages (Kaiser-Hill 1996) Groundwater flow in the Woman Creek Drainage area is strongly affected by topographic relief, the thin, relatively permeable surface deposits, and the topography of the underlying claystone bedrock Groundwater elevations vary seasonally The highest groundwater levels occur in the late winter and spring, and the lowest groundwater levels occur during the late summer and fall

Groundwater flow at the OLF is generally south toward Woman Creek Most groundwater in the OLF area is perched on bedrock in the deeper portions of colluvium and fill (Metcalf & Eddy 1995) Areas of shallow groundwater in the landfill are indicated by areas of thick vegetation and trees The source of this water is the saturated portions of the Rocky Flats Alluvium This groundwater discharges onto the slope below the base of the alluvium, penetrating the colluvium and fill, and either draining further downslope along the top of the weathered claystone or ponding in depressions on the claystone surface (Metcalf & Eddy 1995) Groundwater in the alluvium along Woman Creek is very shallow (within 2 feet bgs) Although borings indicate that most of the claystone bedrock is unsaturated, localized groundwater was encountered in some borings probably associated with isolated fractures that may be in hydrologic communication with Woman Creek alluvium (Metcalf & Eddy 1995)

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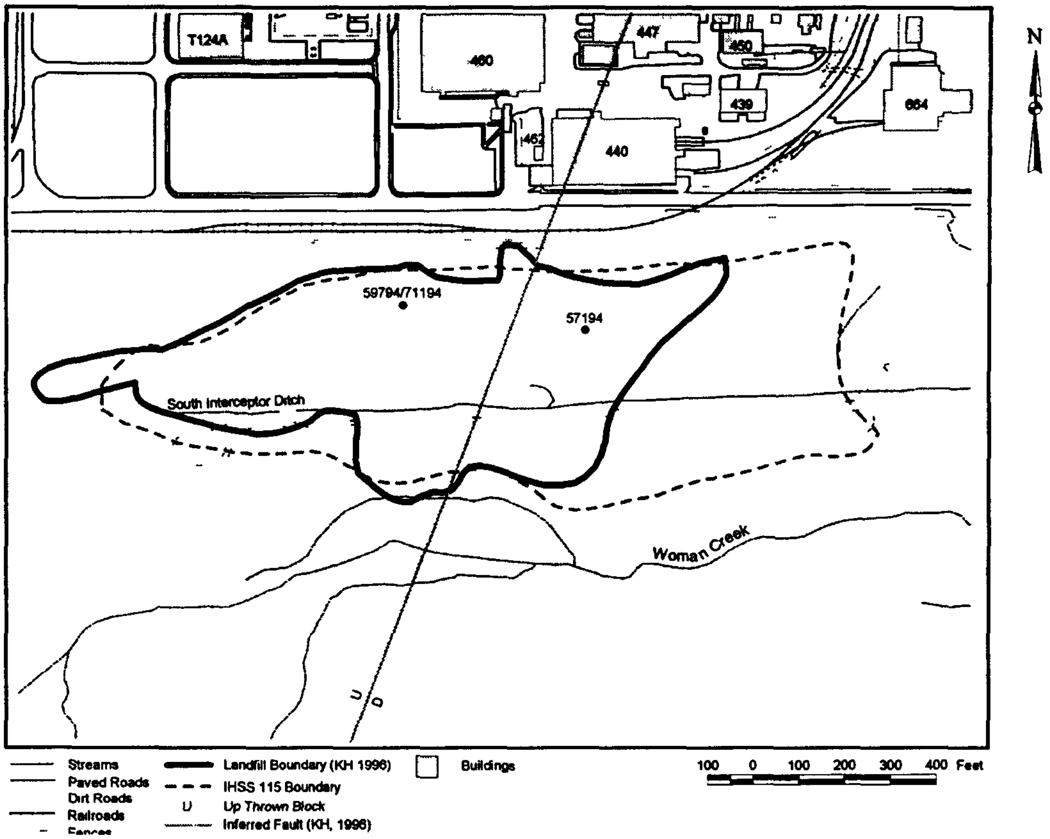
Figure 3-2 Inferred Fault in Original Landfill Area



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3.5 Surface Water

The OLF is located within the Woman Creek drainage basin, which extends eastward from the base of the foothills near the mouth of Coal Creek Canyon to Standley Lake (Figure 3-3) The long-term average annual yield generated by this basin is 32 1 acre-feet, with average storms producing surface flows of 4 to 7 cubic feet per second (cfs) During extreme precipitation events (greater than the 15-year return occurrence based on precipitation), surface flows up to 40 cfs have been generated Although seasonal flows can be low, Woman Creek receives continuous flow from Antelope Springs Creek The reach of Woman Creek adjacent to the OLF is a gaining reach of stream (groundwater discharges to surface water), however, this inflow is likely due to inflow from the south side of the valley and seepage from the old orchard area (Kaiser-Hill 1996)

The Woman Creek drainage basin has an artificial water control structure, the South Interceptor Ditch (SID), which intercepts runoff and routes it to Pond C-2 This runoff would normally flow into Woman Creek or percolate into the underlying subsurface materials of the basin The Woman Creek diversion dam routes all Woman Creek flows less than the 100-year flood peak around Pond C-2 (Kaiser-Hill 1996) With the completion of the Woman Creek Reservoir, located just east of Indiana Street and operated by the city of Westminster, Woman Creek flows are detained in cells of the reservoir until the water quality has been assured by monitoring of RFETS discharges via Woman Creek Reservoir into the Walnut Creek Drainage below Great Western Reservoir

In the past, most natural flows in Woman Creek were diverted to Mower Reservoir and did not exit RFETS via Woman Creek This is no longer the case The Mower Ditch headgates were upgraded, and water in Woman Creek leaves RFETS via Woman Creek (at GS01) and enters the Woman Creek Reservoir In the past, Pond C-2 (located off-channel in the Woman Creek drainage) was sampled and then pumped to the offsite Broomfield Diversion Ditch Currently, RFETS discharges Pond C-2 directly into Woman Creek via pump (at GS31), the water then flows to the Woman Creek Reservoir

3.6 Ecological Setting

Even though the OLF is a highly disturbed industrial site, the area includes the Preble's Meadow Jumping Mouse (PMJM) protection area and wetland areas associated with surface water in the area PMJM is listed as threatened by the U S Fish and Wildlife Service (USFWS) This listing provides special protection for the species under the Endangered Species Act, and potential remedial actions at the OLF must be evaluated for potential impacts to PMJM

PMJM have been identified in all the major drainages of RFETS Rock Creek, Walnut Creek, and Woman Creek, and the Smart Ditch drainages Native plant communities in these areas provide a suitable habitat for this small mammal PMJM at RFETS are restricted to riparian areas and pond margins, apparently requiring multi-strata vegetation with abundant herbaceous cover PMJM populations at RFETS are found in association with the riparian zone and seep wetlands across RFETS The vegetation communities that provide PMJM habitat include the Great Plains riparian woodland complex, tall upland shrubland, wetlands adjacent to these communities, and some of the upland grasslands surrounding these areas Recent studies have

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produced a better understanding of population centers of the species, and studies over the past several years have provided data to help estimate numbers of individuals within each population unit (RFETS 2000)

PMJM have been captured along Woman Creek in the area of the OLF where a significant amount of suitable habitat occurs The PMJM were captured in riparian areas with well-developed shrub canopies and a relatively lush understory of grasses and forbs This is typical of habitats occupied by the subspecies throughout its range (Kaiser-Hill 1996) The PMJM habitat and buffer area (Figure 3-4) includes a portion of the OLF area below the SID The PMJM habitat and buffer area continues east-west along Woman Creek

Jurisdiction wetlands in the OLF area are also shown on Figure 3-4 Within the OLF area, the area directly surrounding the SID has been designated as jurisdictional wetlands South of the landfill wetland areas are associated with springs and riparian fringe in the Woman Creek drainage The SID wetlands were created when the ditch was built, and may be considered isolated wetlands The SID wetland is a narrow, linear system, dominated by cattails and coyote willow, and as such, have lower functional integrity than natural wetlands associated with Woman Creek

Figure 3-3 Surface Water Features

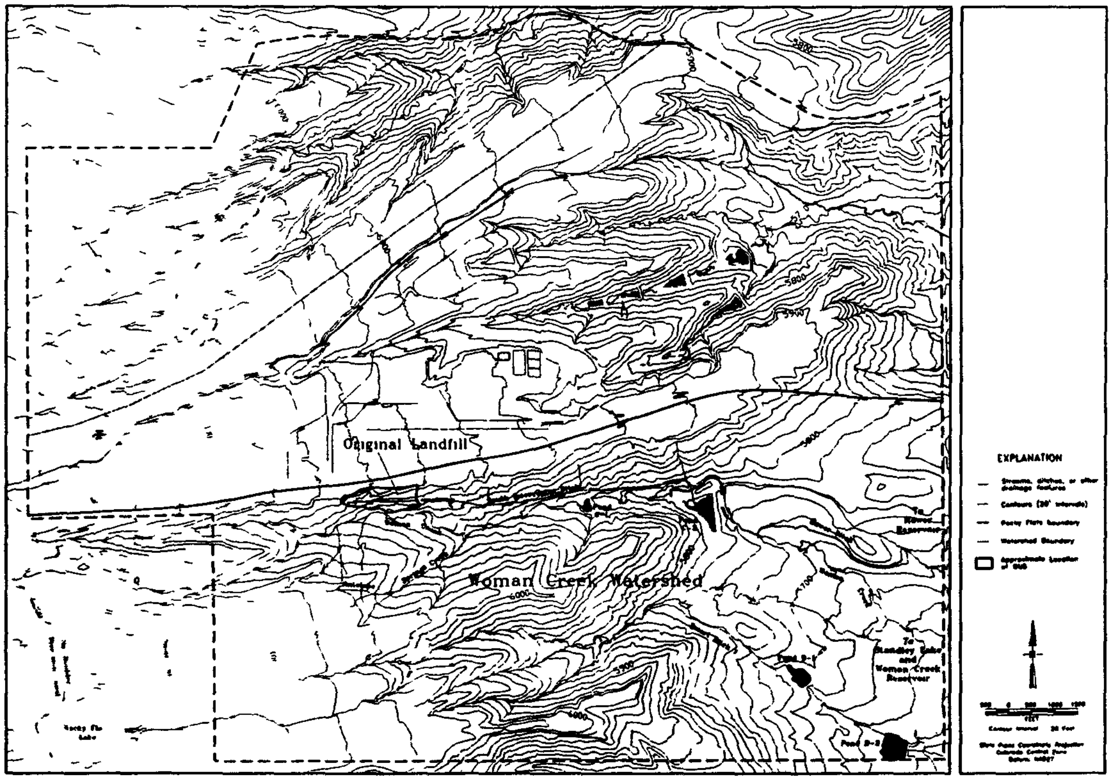

Figure 2 4

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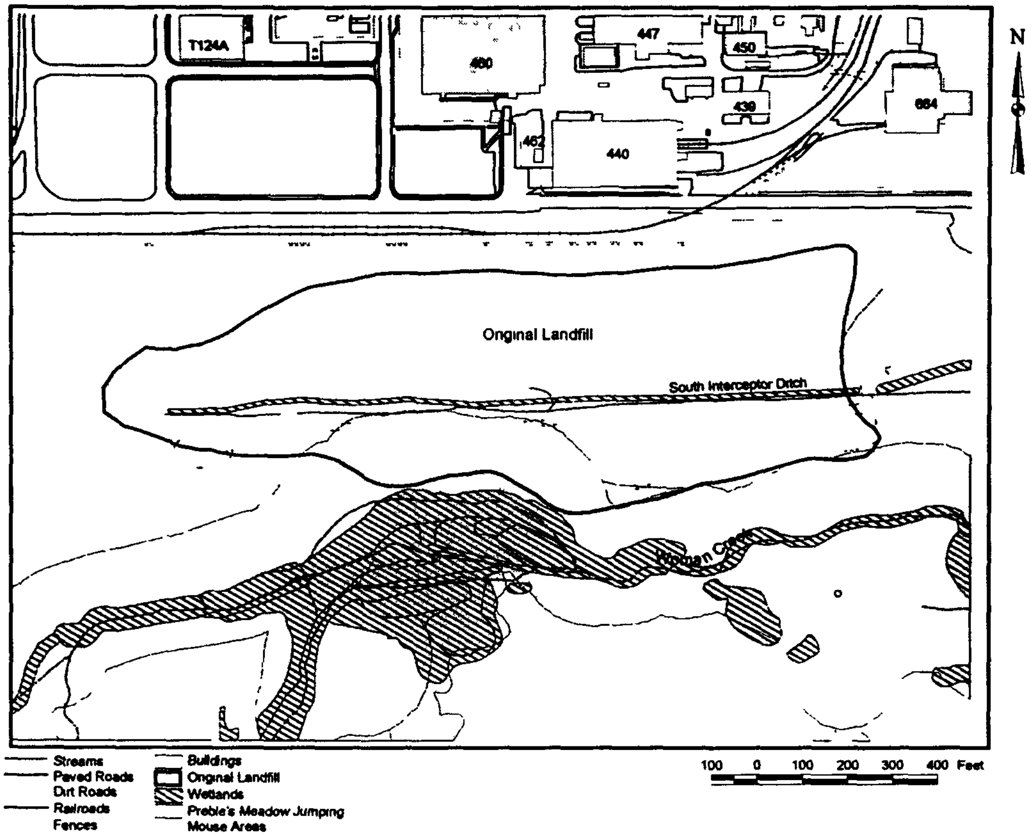
Figure 3-4 Wetlands and PMJM Areas Near the Original Landfill



4.0 NATURE AND EXTENT OF CONTAMINATION

The contamination source is the waste disposed at the IHSS Group SW-2 Original Landfill (OLF), as previously described in section 2 0 This section describes the environmental media investigation, characterization activities, and resulting data for the OLF This section evaluates the nature and extent of contamination in surface soil, subsurface soil, groundwater, and surface water to be addressed by the proposed accelerated action, the presumptive remedy of source containment and "hot spot" removal In addition, the results of a Baseline Risk Assessment for the OLF are summarized and soil and water contaminant levels are evaluated in relation to the *RFETS Action Levels and Standards Framework for Surface Water, Ground Water and Soils*, RFCA Attachment 5 (ALF)

4.1 Site Characterization Data

The data used to characterize the nature and extent of contamination in and around the OLF was collected primarily in the early 1990s and is documented in the Operable Unit 5 (OU 5) Phase 1

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Remedial Investigation/RCRA Facility Investigation Report (OU-5 Phase 1 RI/RFI) (Kaiser-Hill 1996) The OLF coincides with OU-5 Phase 1 RFI/RI Area of Concern 1

Additional sampling of groundwater and surface water at or in the proximity of the OLF has occurred since that time This sampling and analysis is planned and documented in accordance with the RFCA *Integrated Monitoring Plan* (IMP) (DOE et al 1997) The RFCA Parties evaluate the IMP annually for adequacy and changes based on previous monitoring results, changed conditions, planned activities and public input are made with the approval of CDPHE and EPA

The scope of the OU 5 Phase 1 RI/RFI is presented in the OU 5 Phase 1 RFI/RI Work Plan (OU 5 Work Plan) (EG&G 1992b) The OU 5 Work Plan includes the rationale for the number and location of samples and was reviewed and subsequently approved by EPA and CDPHE, and issued on February 28, 1992 (EPA 1992a, 1992b, CDPHE 1992) Development of the OU 5 Work Plan included a Data Quality Objective process to describe the quantity and quality of data required Data needs were identified to characterize the physical and hydrogeological setting, to assess the presence of contamination at each site, to characterize the nature and extent of contamination, and to support the evaluation of remedial alternatives based on effectiveness, implementability and cost The type, number and location of samples were based on meeting these needs

Sampling locations were selected based on earlier investigations and reviews of historical records, which included earlier groundwater and surface water analytical data, aerial photographs, site records, magnetometer survey, and radiation surveys All sampling and analysis activities were conducted in accordance with the Quality Assurance requirements of the OU 5 Work Plan Data gaps were identified based upon the results of the initial sampling and additional sampling and geotechnical investigation work was performed to fill these gaps

The sampling program resulted in the following data relevant to the OLF

- Surface Soil 7,568 validated analyses from 70 surface locations
- Borehole samples to bedrock 24,964 validated analyses from 175 soil samples
- Groundwater 31,171 validated analyses from 213 samples from 50 wells
- Surface Water 25,384 validated analyses from 15 locations

Investigations also included geotechnical evaluations, groundwater investigations, hydrogeological testing, storm sewer sampling, and air monitoring Other investigations conducted in the same timeframe included the following

- Field Instrument Detection Low Energy Radiation and High Purity Germanium gamma radiation surveys to detect and identify near surface areas of contamination from radioactive materials
- Magnetometer survey to locate ferrous materials and anomalies

- Electromagnetic survey to delineate dump boundaries, saturated materials, and anomalies

- Cone penetrometer tests to gather geotechnical information on the waste fill, alluvium and bedrock

- Soil gas survey for volatile organic compounds and combustible gasses to locate possible sources of these constituents

4.2 Data Compilation and Evaluation

The OU 5 Phase 1 RFI/RI Report fully compiles, discusses and evaluates the results of the OU 5 RFI/RI sampling activities To simplify and focus the evaluation of the source containment presumptive remedy, the analytical data relevant to the OLF were extracted from the RFETS Soil Water Database (SWD)

These data include the OU 5 RFI/RI data as well as the groundwater and surface water data that have been collected since the RFI/RI In extracting the data from SWD, all data rejected during data validation were eliminated Also, data with unusual concentration units were eliminated rather than use professional judgment to determine if the units are correct or should be changed Examples include radionuclides reported in parts per billion (ppb) rather than picocuries per liter (pCi/L), and metal concentrations in water reported in milligrams per liter (mg/l) rather than micrograms per liter (ug/L) The data with unusual units typically represents less than 5% of all the data for the given analytical suite and medium

Analytical data for soil, groundwater and surface water have been compared to RFETS background levels and to the action levels and standards (ALs) in ALF The comparison to background levels is used to determine if analyte concentrations in each environmental medium are representative of contamination The comparison to RFCA ALs is made so that the evaluation triggered by contaminant concentrations above RFCA ALs can be demonstrated and discussed in relation to the proposed accelerated action

Background levels for metals and radionuclides in subsurface soil, groundwater (total concentrations for the Upper Hydrostratigraphic Unit), and surface water (total concentrations for streams) are from the Background Geochemical Characterization Report (DOE 1993) Background values for surface soils are from the Geochemical Characterization of Background Surface Soils Background Soils Characterization Program (DOE 1995) Because of difficulties in determining the appropriate background concentration for organic compounds, any detection of an organic compound is considered an above background observation

The data relevant to the OLF have been summarized in tables presented in this section Summary tables are presented for surface soil (surface soil samples and borehole samples where the surface is the starting depth for the interval), subsurface soil (borehole samples where the starting depth for the interval is below the surface), groundwater, upgradient Woman Creek surface water (stations SW039, SW040, SW041, and SW506), downgradient Woman Creek surface water (stations SW032, SW033, SW034, SW10295, SW50193, and SW50293), and South Interceptor Ditch surface water (stations SW036, SW038, SW129, and SW500) These summary tables show analytes that were detected above background in order to limit the summary tables to analytes that are potentially contaminants The full suites of analyses performed on the samples are identified in the table notes In these tables, the following decision rules were applied to the calculation of summary statistics·

1. Data rejected during validation were eliminated from the data set before computing statistics
2. The minimum value represents the lowest value observed for the analyte regardless of whether it was detected or not detected (non-detected results have an attached U qualifier which signifies that the analyte was not detected at the concentration reported)
3. The maximum value is the highest detected value reported
4. The average was computed using replacement values for the data that were non-detects (U-qualified data) The replacement value is one-half the value reported with the attached U qualification)

Surface soil, subsurface soil, groundwater and surface water sample locations are shown on Figure 4-1

4.3 Surface Soil

As shown in Table 4-1, there are many metals, radionuclides, and organic compounds that have been detected above background levels in surface soil, however, only uranium and few polynuclear aromatic hydrocarbons (PAHs) are present in surface soil above the RFCA ALs Metals and other radionuclides were infrequently detected above background, and with the exception of PAHs, organic compounds were rarely detected

Uranium contamination is present in surface soil above the ALs in four samples As shown in Figure 4-2, one sample location is on the northwestern boundary of the OLF This area was initially identified by gamma radiation surveys, which indicated it is a small, localized area of contamination The uranium contamination at this location coincides with the action discussed in section 2 5 for debris that became exposed to the surface in April 1990, which was surveyed and determined to be contaminated with depleted uranium It was further investigated in accordance with the OU-5 Phase 1 RFI/RI Work Plan

The other three samples containing uranium contamination that are above the ALs are present in the center of the landfill Elevated gamma radiation in the area of these three samples was initially identified by the 1990 gamma radiation survey and was further investigated in accordance with the OU 5 Phase 1 RFI/RI Work Plan The OU 5 Phase 1 RFI/RI Work Plan gamma survey identified nine areas of elevated radiation roughly bounded by the surface soil locations with the above AL uranium concentrations (surface soil location SS15693 located just to the north also has elevated uranium isotope concentrations, but they are not above the ALs) The uranium contamination at this location could be a remnant of the depleted uranium cleanup operation that occurred in response to the dumping of 60 kg of burning depleted uranium discussed in section 2 2 However, it also coincides with the area where debris materials were removed in May, 1993 during the conduct of the OU 5 Phase 1 RFI/RI Work Plan radiation surveys discussed in section 2 5.

Examination of the uranium isotope concentrations shown on Figure 4-2 indicates that the four sample locations with uranium isotope concentrations above ALs have a U-238/U-234 ratio of

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approximately 10, which is indicative of depleted uranium The other above background concentrations of uranium in the area indicate a U-238/U-234 ratio of approximately 1, which is indicative of natural uranium, and accordingly, are not likely to represent contamination even though the concentrations are above background

An action determination in accordance with ALF, section 5 3 has been made for the soils associated with the four samples of uranium concentrations above the AL These "hot spots" will be removed in accordance with the Environmental Restoration RFCA Standard Operating Protocol for Routine Soil Remediation under this IM/IRA

With respect to the PAHs, as shown on Figure 4-3, these compounds are ubiquitous in surface soil at the OLF However, two sample locations have PAH concentrations that exceed the ALs, and only one of these locations shows an exceedance with a wide margin above the AL (benzo(a) pyrene at SS10593) However, it is noted that the average concentrations of the PAHs are all below the AL (Table 4-1) Because the PAHs are largely confined to the surface (see Section 4 4), it is likely they are present in the soil because of PAH contaminated runoff from paved areas in the Industrial Area It is also possible they are associated with the dumping of street sweeping materials on the surface of the OLF discussed in section 2 2

An action determination in accordance with ALF, section 4 2 has been made for the soils associated with the two samples with PAH concentrations above the AL These locations are fairly close to the depleted uranium soil sample locations that will be removed as "hot spots", and it is assumed that these areas can be addressed at the same time Environmental Restoration RFCA Standard Operating Protocol for Routine Soil Remediation will be used to remove these "hot spots" under this IM/IRA

4.4 Subsurface Soil

Like surface soil, there are many metals and radionuclides that have been detected above background levels in subsurface soil, however, unlike surface soil, PAHs were the only organics detected, and uranium isotope concentrations were not detected above the ALs (Table 4-2) The PAHs are present in the subsurface soil above the RFCA ALs In subsurface soil, metals, radionuclides, and the PAHs infrequently exceed background levels Although the PAHs are present at isolated locations above the ALs (Figure 4-4), the average PAH concentrations in subsurface soil are below the ALs (Table 3-2) The much higher frequency of PAH detections in surface soil is indicative that the PAH source component is from the soil cover, or is external and has contaminated the soil cover It is possible that disposed wastes included asphalt and street sweepings and that there is a PAH source component in the subsurface waste An action determination in accordance with ALF, section 4 2 has been made for the PAH contaminated soils and the proposed accelerated action of source containment shall be conducted in accordance with this IM/IRA The use of the Soil Risk Screen pursuant to ALF section 4 2 A for the action determination is discussed in section 5 0 of this IM/IRA

4.5 Groundwater

As shown in Table 4-3, metals and radionuclides have been detected in groundwater at levels above background, and several organic compounds have also been detected The sample results

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for many of these analytes exceed their respective Tier II ALs. However, the frequency of exceeding background or the Tier II ALs was generally very low, with uranium-238 having the highest frequency of exceeding the Tier II AL (two samples exceeded Tier I)

For the nonradioactive inorganics, antimony and selenium average concentrations are greater than their Tier II ALs However, the antimony Tier II AL is lower than its background concentration and the frequency of samples above the Tier II AL is very low The selenium average concentration is greater than its Tier II AL and the Tier II AL is greater than the selenium background concentration

With the exception of manganese and selenium, the concentrations of metals in the groundwater rarely exceeded the Tier II AL Although manganese has the highest frequency of exceeding background and the Tier II AL, the average concentration was below the Tier II AL

There is no surface water AL for manganese, and therefore, manganese contaminated groundwater does not present a surface water quality concern With respect to selenium, the average concentration in groundwater samples (60 8 ug/L) exceeded the Tier II AL (50 ug/L) [and the surface water AL of 4 6 ug/L] A closer examination of selenium concentrations in groundwater samples shows there are only three locations where the maximum concentration of selenium exceeded the Tier II AL (Figure 4-5) The maximum concentration of selenium of 59 5 ug/L at well 59793 is the only selenium datum for this well, and the well is not routinely sampled pursuant to the IMP

Well 7086, just to the southwest of well 59793, is an IMP Plume Extent monitoring well The maximum concentration of 257 ug/L appears to be an outlier because the balance of the selenium data for this well indicates very low concentrations of this metal, all of which were below the Tier II AL (Figure 4-6) The other location where the maximum selenium concentration exceeded the AL is well 10994, also an IMP Plume Extent monitoring well, located east of the OLF (Figure 4-5) As shown in Figure 4-7, concentrations were relatively high, averaging 500-600ug/L, well above the Tier II AL and background This well is sidegradient to the OLF, and the selenium concentrations are similar to those found in monitoring wells 10992 and COLWEL 891 located at the 881 hillside (DOE 2003) Therefore, the OLF does not appear to be the source for the selenium observed at this location Furthermore, selenium does not appear to be a water quality concern at downgradient stations along Woman Creek (see Section 4 6), which would be the closest potentially impacted surface water relative to the location of well 10994

Of the radionuclides, only uranium appears to be of any concern in groundwater Plutonium and americium were infrequently detected above the Tier II Als and the average concentrations are below the Tier II Als and surface water Als The average radium-226 concentration of 1 2 pCi/L was well below the Tier II AL of 20 pCi/L, and the average strontium-90 concentrations of 0 47 pCi/L was below the Tier II AL of 0 852 (and the maximum concentration of 5 55 pCi/L was below the surface water AL of 8 pCi/L). With respect to uranium, exceedances of the Tier II ALs for uranium-238 and uranium-233,234 were relatively frequent, however, exceedances of the background levels were rare This is a result of the Tier II ALs being an order of magnitude lower than the background levels Review of Figure 4-8 shows there are only three wells where the maximum concentrations of the isotopes exceeded background, two of which had a concentration that also exceeded the Tier I AL, but only by a small margin

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To further evaluate whether the uranium in groundwater is naturally occurring, the total uranium concentrations and the U-238/U-234 ratios for the three wells where concentrations have exceeded background were plotted (Figure 4-9) As can be seen by this figure, there is no clear trend of an increasing U-238/U-234 ratio with increasing concentration, which would otherwise indicate contamination with depleted uranium (depleted uranium has a U-238/U-234 ratio of approximately 10, whereas natural uranium has a ratio of approximately 1) Although the U-238/U-234 ratio increases with concentration in well 61093 (maximum ratio of approximately 4), this trend is not apparent for well 59993 where the ratio is approximately 1 regardless of the concentration Furthermore, the well with the highest uranium concentration, well 58693, also had a U-238/U-234 ratio of 1 indicating the uranium is natural

Because well 61093 is located within the bounds of the depleted uranium "hot spot" in surface soil, and the highest U-238/U-234 ratio is reported for this well, the possibility of low level contamination of groundwater with depleted uranium cannot be ruled out A sample from well 61093 was collected and analyzed for uranium-235, uranium-236, and uranium-238 using Inductively Coupled Plasma/Mass Spectrometry (ICP/MS) as part of a joint CDPHE/RFETS program to determine where uranium is naturally occurring on Site (CDPHE 1999) The results for the well 61093 sample indicate a U235/U238 ratio of 0 002427, which is indicative of the presence of depleted uranium (natural uranium has a U235/U238 ratio of 0 0072) The sample also contained uranium-236, which is not a naturally occurring isotope These results also suggest that there is a depleted uranium source for the contamination However, even if there is a depleted uranium source contributing to the uranium concentration observed in the groundwater, the impact is small because the concentrations are not significantly different from background concentrations

An action determination in accordance with ALF, section 3 3 has been made for the uranium ground water contamination There is no indication that groundwater is causing surface water standards in Woman Creek to be exceeded by the contents of the OLF despite no groundwater controls after the waste disposal operations ceased Possible impacts to the SID are discussed in Section 4 6 3 Monitoring in accordance with the IMP will continue to evaluate contaminant concentration changes or trends

Table 4-3 also indicates that organic compounds, are occasionally detected in groundwater in or near the OLF The most frequently detected compound, albeit at a low frequency, is trichloroethene (TCE) Figure 4-10 shows the maximum concentrations of TCE in wells at or near the OLF Review of this figure indicates that TCE has been detected in groundwater throughout this area In several locations, the maximum concentrations exceeded the Tier II AL, however, the concentrations overall are generally very low (< 10 ug/L) The exceptions to this rule are the maximum concentrations of TCE in wells 60993 and 61093, located in the middle of the OLF TCE concentrations for these wells, and the other wells where TCE was detected, were plotted against time to further evaluate the nature of TCE contamination As can be seen from Figure 4-11, most wells consistently have very low (<10 ug/L) TCE concentrations Although well 61093 had a maximum TCE concentration of 140 ug/L, the concentration continually dropped off in the subsequent two samplings of this well, with only 13 ug/L of TCE reported in the last sample collected from this well There is only one datum for well 60993 (85 ug/L), and therefore, a conclusion cannot be drawn regarding the nature of the TCE contamination at this well Nevertheless, in aggregate, the TCE data indicate that the OLF is not a significant source for TCE contamination of groundwater Additionally, a groundwater contaminate plume has been identified from the Industrial Area that may exhibit TCE contamination at the OLF. This IA area of contamination is being evaluated in the Site-wide Groundwater IM/IRA

An action determination in accordance with ALF, section 3 3 has been made for the TCE ground water contamination There is no indication that groundwater or an increasing plume is causing surface water standards to be exceeded by the contents of the OLF, despite no groundwater controls after the waste disposal operations ceased Monitoring in accordance with the IMP will evaluate contaminant concentration changes or trends

In summary, groundwater does not require remediation based on exceedances of ALs Well 10994 with high selenium concentrations is located east of the OLF, and therefore the OLF is not the apparent source for the contamination Furthermore, the selenium concentrations are below the Tier I AL Although uranium was frequently detected above the Tier II ALs and occasionally above the Tier I AL (uranium-238), concentrations are near background levels even if there is some contribution from a depleted uranium source within the OLF TCE contamination is fairly widespread but at trace levels and there does not appear to be an increasing plume emanating from the highest observed concentrations Thus, the OLF is also not a significant source for this contamination

4.6 Surface Water

Surface water quality data has been evaluated through comparison to RFETS background levels and surface water ALs, but also through comparison to upstream conditions The latter analysis was performed because of the potential for surface water contamination from other upstream sources

4.6.1 Upstream Woman Creek Surface Water Quality

As shown in Table 4-4, there are several metals, radionuclides, and organic compounds that have been detected above background levels in upstream surface water within Woman Creek Many of these analytes also exceeded the RFCA surface water ALs Although this data may indicate upstream surface water contamination, the exceedances of background and the ALs were generally very infrequent indicating the water quality routinely meets standards

4.6.2 Downstream Woman Creek Surface Water Quality

As shown in Table 4-5, like upstream surface water quality, there are several metals, radionuclides, and organic compounds that have been detected above background levels in downstream surface water within Woman Creek Many of these analytes also exceeded the RFCA surface water ALs Like upstream surface water quality, the exceedances of background and the ALs are generally very infrequent indicating the water quality routinely meets standards

Because selenium was not a metal present in upstream Woman Creek surface water, and was at high concentrations in groundwater east of the OLF, the downstream Woman Creek surface water data was reviewed for this analyte Figure 4-12 shows concentrations of selenium at downstream surface water stations over time The figure indicates that selenium exceeded the surface water AL only at stations SW032 and SW033, however, the selenium exceedances were infrequent These stations are closest to well 10994 where groundwater contains high concentrations of selenium Because the selenium exceedances above the AL in downstream Woman Creek surface water are infrequent, and the source of the selenium is not the OLF. An action for selenium is not addressed in this IM/IRA Relative to upstream Woman Creek surface water, there are somewhat higher frequencies of background and AL exceedances for plutonium, americium, and the uranium isotopes Plutonium and americium have not been identified as analytes of concern in soil or groundwater at the OLF The frequency of above background levels in downstream Woman Creek surface water may be due to the surface water stations being located further east, closer to the 903 Pad, the major source of wide-spread plutonium and americium in surface soils at RFETS With respect to uranium, because there are no isotope-specific uranium surface water ALs, Table 4-5 does not indicate AL exceedances for the isotopes However, there is a total uranium surface water AL, which is 11 pCi/L for Woman Creek Because the maximum concentrations of the uraniun-233,234 and uranium-238 isotopes are less than 73% of the AL, and the average concentrations of these isotopes were less than 1 pCi/L, it is concluded that an action for uranium in downstream Woman Creek surface water is not required

4.6.3 South Interceptor Ditch Surface Water Quality

As shown in Table 4-6, similar to upstream and downstream surface water quality in Woman Creek, there are several metals, radionuclides, and organic compounds that have been detected above background levels in the South Interceptor Ditch (SID) surface water Many of these analytes also exceeded the RFCA surface water ALs Like Woman Creek surface water quality, the exceedances of background and the ALs are generally very infrequent Notable exceptions include barium, and the uranium isotopes

As shown in Table 4-3, barium is present above background in groundwater but rarelv has it exceeded the Tier II groundwater ALs Groundwater infiltration to the SID is a plausible explanation for the above background barium concentrations in SID surface water However, like groundwater, exceedances of the surface water AL are rare (only one reported exceedance [see Table 4-6])

Two exceedances of the AL for tritium have been reported, one in 1988 (2990 pCi/L at SW036) and one in 1992 (700 pCi/L at SW038) The average concentration for tritium is below the AL and the surface water background Tritium has a short half-life (12 4 years) compared to uranium and is not reported above background or the Tier II AL for ground water at the OLF Thus, the OLF does not appear to be a source of tritium contamination.

Unlike Woman Creek surface water, there is a relatively high frequency of exceedances above background for the uranium isotopes Because there are no isotope-specific uranium surface water ALs, Table 4-6 (like Table 4-5) does not indicate AL exceedances for the isotopes However, unlike downstream Woman Creek surface water, the maximum concentrations of uranium 233,234 and uranium-238 exceed the surface water AL of 11 pCi/L of total uranium A review of the surface water uranium data shows that only SW036 has total uranium concentrations that exceed the surface AL The other stations on the SID have low concentrations of total uranium (< 5 pCi) As shown in Figure 4-13, total uranium concentrations average about 20 pCi/L at SW036, and are rarely below the surface water AL

Because uranium concentrations in groundwater are at levels much higher than the surface water AL, discharge of groundwater to SID surface water (interflow) could be a contributing source of the high concentrations of uranium at SW036 and the exceedances of the surface water AL Such interflow is observed at this station because there continues to be flow at the station long after precipitation events, and in the absence of any runoff. However, runoff from known surface soil contamination, described in section 4 3, could also be a contributing source Also shown on Figure 4-13 are the U-238/U-234 ratios, which are typically about 3 This indicates there may be a depleted uranium component to the uranium observed in surface water at this station As discussed in Section 4 5, there is some possibility of a depleted uranium release to groundwater However, it should be noted that uranium concentrations are largely at background levels in groundwater, and therefore, most of the uranium observed in surface water at SW036 could be naturally occurring

4.6.4 Surface Water Quality Conclusions

Based on the above observations, remediation of the OLF to protect surface water quality appears to be limited to the possible depleted uranium in the SID at SW-036 Pursuant to ALF, section 5 3 E, additional soil may need to be remediated or managed to protect surface water quality in accordance with ALF section 2 0 Surface water ALs for uranium are not exceeded at the Woman Creek Points of Evaluation or Points of Compliance Uranium hot spots will be removed and the source containment action will adequately cover any remaining surface soils

4.7 Risk Assessments

As part of the OU 5 Phase I RFI/RI work a baseline human health risk assessment was conducted for Area of Concern 1, which is identical to the OLF area (Kaiser-Hill 1996) Although risk and health effect calculations were made for several receptors and exposure pathways, those most relevant to the future anticipated land used for RFETS were the open space user and the ecological researcher The total estimated risk for the open space user was calculated as 6E-6 and for the ecological researcher as 1E-6

An ecological risk assessment was conducted for several RFETS areas, including the Woman Creek Watershed, which is also contained in the OU 5 Phase I RFI/RI Report (Kaiser-Hill 1996) The methodology was developed to support risk management decisions for individual Operable Units The approach used for the assessment is consistent with a screening-level risk assessment appropriate for sites where ecological effects have not been observed, but contaminant levels have been measured and can be compared with concentrations considered protective of ecological receptors

Relevant to the OLF source area, the evaluated Receptor Groups and related Ecological Contaminants of Concern were as follows

- Aquatic Life – Metals and organics in sediments,
- Aquatic feeding birds – Mercury in fish tissue and antimony in sediments,
- Small mammals- Uranium 233/234 and 238 in soils,

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- Vegetation – Metals in soils and sediments

In summary, the assessment concluded

- PAHs were the primary risk to aquatic life, but no toxicity was detected in sediment toxicity tests with *Hyalella azteca*,
- Risks from mercury to aquatic feeding birds were significant only if birds obtained all their food from pond C-1,
- Risks from antimony to aquatic feeding birds assumed 100% site use, but the streams support a small fish population and risks were not significant if adjusted for realistic site use factors,
- Radionuclides do not present a significant risk to terrestrial receptors,
- Risk to vegetation communities is minimal because of small source areas and growth of vegetation in contaminated sediment in littoral zones appears normal

Based on the risk assessment information, baseline risks appear to be well within CERCLA threshold criteria The presumptive remedy of source containment is expected to maintain or lower the baseline risks

Table 4-1
Surface Soil Contamination Summary

Analyte	Total number of samples	Number of samples exceeding BG[1] but less than the AL	Number of samples exceeding the AL	Minimum Conc.	Maximum Conc.	StDev. of Conc.	Average Conc.	AL	BG
Inorganics (mg/kg)									
Aluminum	55	2	0	4560	20000	3556	10280	228000	16902
Barium	55	6	0	47 6	177	31 0	107	26400	141.26
Beryllium	55	9	0	0 145	1 7	0.35	0 54	921	0 966
Cadmium	48	2	0	0 215	4 1	0 69	0 51	962	1 612
Chromium	55	5	0	3 7	24 2	3 86	12 08	268	16 99
Cobalt	55	1	0	2 6	13 6	1 49	4 19	1550	10 91
Copper	55	19	0	2 7	184	34 21	28 83	40900	18 06
Iron	55	4	0	8360	22000	3003	13718	307000	18037
Lead	33	1	0	5 8	129	21 3	22 76	1000	54 62
Manganese	55	4	0	107	829	109 4	252	3480	365 08
Mercury	55	12	0	0 03	0 38	0 091	0 097	25200	0 134
Nickel	54	21	0	3 3	26 3	4 58	13 58	20400	14 91
Strontium	55	1	0	5 9	52 8	7 15	14 41	613000	48 94
Zinc	55	10	0	11 8	199	34 7	57 81	307000	73 76
Radionuclides (pCi/g)									
Americium-241	67	13	0	-0 095	0 0865	0 021	0 014	76	0 0227
Plutonium-239/240	69	16	0	-0 065	0 3378	0 060	0 048	50	0 066
Uranium-234	70	10	1	0.218	2800	335	46 70	300	2.253

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Table 4-1
Surface Soil Contamination Summary

Analyte	Total number of samples	Number of samples exceeding BG[1] but less than the AL	Number of samples exceeding the AL	Minimum Conc	Maximum Conc	StDev of Conc	Average Conc	AL	BG
Uranium-235+D	70	5	4	0	670	80 12	10 90	8	0 0939
Uranium-238+D	70	12	4	0 2827	38000	4543	599	351	2
Organics (ug/kg)									
2-Methylnaphthalene	50	4	0	100	12000	1656	551	20400000	
4,4-DDD	52	1	0	55	46	7 4	16 49	143000	
4,4'-DDT	52	1	0	55	46	7 4	16 48	100000	
Acenaphthene	53	17	0	56	43000	5867	1161	40800000	
Aldrin	52	4	0	2 7	67	10 45	10 82	1620	
Anthracene	53	19	0	69	30000	4089	921	2 04E+08	
Aroclor-1254	52	12	0	55	3900	688	432	12400	
Benzo(a)anthracene	50	28	1	64	40000	5632	1291	34900	
Benzo(a)pyrene	52	23	2	9 5	43000	5928	1310	3490	
Benzo(b)fluoranthene	53	24	1	7	48000	6566	1499	34900	
Benzo(k)fluoranthene	51	16	0	59	16000	2205	706	349000	
Benzoic Acid	19	3	0	155	1250	385	613	1E+09	
bis(2-Ethylhexyl)phthalate	51	8	0	47 5	480	131 7	275	1970000	
Butylbenzylphthalate	51	1	0	175	480	100 8	316	1 47E+08	
Chrysene	52	28	0	60	37000	5114	1209	3490000	
Dibenz(a,h)anthracene	40	5	1	12	7000	1077	455	3490	
Dibenzofuran	51	8	0	49	20000	2762	704	2950000	
Dieldrin	52	4	0	5 5	53	9 18	18 12	1720	
Di-n-butylphthalate	51	8	0	40	480	125	279	73700000	
Di-n-octylphthalate	51	1	0	83	480	105	310	14700000	
Endosulfan sulfate	52	1	0	55	46	7 41	16 55	4420000	
Endrin	52	3	0	5 5	200	31 34	24 37	221000	
Fluoranthene	53	40	0	68	73000	10063	2232	27200000	
Fluorene	53	15	0	39	32000	4362	921	40800000	
Heptachlor epoxide	52	1	0	2 7	23	4 01	8 55	3030	
Indeno(1,2,3-cd)pyrene	39	16	0	18	28000	4449	1088	34900	
Methoxychlor	52	1	0	27	450	62 87	89 07	5110000	
Naphthalene	53	7	0	39	26000	3541	859	3090000	

Note Analytes shown are those that were detected at least once above background levels and have a Wildlife Refuge Worker Action Level Surface soil samples were analyzed for Target Analyte List (TAL) metals gross alpha and beta uranium-233 234 uranium-235 uranium-238 americium-241 plutonium-239 240 and Target Compound List Volatile Organic Compounds Semi Volatile Organic Compounds and Pesticides/PCBs

BG - Background

AL - Action Level

StDev - Standard Deviation

[1] Organic detections estimated or otherwise are considered to be above background concentrations

Above AL

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Table 4-2
Subsurface Soil Contamination Summary

Analyte	Total number of samples	Number of samples exceeding BG[1] but less than the AL	Number of samples exceeding the AL	Minimum Conc.	Maximum Conc.	StDev. of Conc.	Average Conc.	BG	AL
Inorganics (mg/kg)									
Antimony	116	4	0	1 2	23 6	4 07	5 13	16 97	409
Arsenic	146	1	0	0 115	16 8	2 38	4 46	13 14	22 2
Barium	161	1	0	1 4	387	57 57	107	289 38	26400
Cadmium	160	1	0	0 12	2 3	0 26	0 35	1 7	962
Chromium	161	5	0	3 8	165	21 19	17 17	68 27	268
Copper	161	12	0	2	6920	547	68 31	38 21	40900
Iron	160	1	0	4410	49500	5891	1492	41046 52	307000
Lead	104	2	0	2 7	132	15 38	14 96	24 97	1000
Manganese	161	4	0	40 7	1540	217	256	901 62	3480
Molybdenum	163	1	0	0 26	190	15 10	3 48	25 61	5110
Nickel	161	7	0	2 25	118	17 49	17 90	62.21	20400
Silver	150	1	0	0 215	36	3 43	1 23	24 54	5110
Zinc	161	11	0	5 9	673	88 51	69 68	139 1	307000
Radionuclides (pCi/g)									
Americium-241	145	16	0	-0 0119	0 46	0 050	0 017	0 02	76
Plutonium-239/240	159	24	0	-0 003	3 2	0 27	0 044	0 02	50
Uranium-234	150	4	0	0 275	15	1 29	1 15	2 64	300
Uranium-235+D	150	12	0	-0 0031	2 3	0 19	0 075	0 12	8
Uranium-238+D	149	10	0	0 28	6	0 60	1 03	1 49	351
Organics (ug/kg)									
Benzo(a)anthracene	129	2	2	43	48000	5466	1049		34900
Benzo(a)pyrene	129	2	2	40	43000	4071	810		3490
Benzo(b)fluoranthene	129	2	2	75	48000	5471	1060		34900

Note Analytes shown are those that were detected at least once above background levels and have a Wildlife Refuge Worker Action Level Subsurface soil samples were analyzed for Target Analyte List (TAL) metals, gross alpha and beta, uranium-233,234, uranium-235, uranium-238, americium-241, plutonium-239,240, and Target Compound List Volatile Organic Compounds, Semi-Volatile Organic Compounds, and Pesticides/PCBs

BG - Background

AL - Action Level

StDev - Standard Deviation

[1] Organic detections, estimated or otherwise, are considered to be above background concentrations

Above AL

42

Table 4-3
Groundwater Quality Summary

Analyte	Total Number of Samples	Number of Samples Exceeding Tier I AL	Number of Samples Exceeding Tier II AL but less than Tier I AL	Number of Samples Exceeding BG[1] but less than Tier II AL	Number of Wells Exceeding Tier II AL but less than Tier I AL	Number of Wells Exceeding BG but less than Tier II AL	Minimum Conc.	Maximum Conc.	StDev. of Conc.	Average Conc.	Tier I AL	Tier II AL	BG[1]
Inorganics (ug/L)													
Aluminum	252	0	10	16	[illegible]	7	[illegible]	[illegible]	29559	6184	3650000	[illegible]	[illegible]
Antimony*	251	0	2	3	[illegible]	3	0.07	[illegible]	9.98	11.58	600	[illegible]	[illegible]
Arsenic	253	0	0	14	0	7	0 16	23 2	3 23	2 04	5000	50	5 37
Barium	261	0	2	72	2	12	[illegible]	4710	384	184	200000	2000	[illegible]
Beryllium	253	0	6	2	[illegible]	2	0.005	[illegible]	395	0.86	400	[illegible]	[illegible]
Cadmium	254	0	5	0	[illegible]	0	0.0085	[illegible]	[illegible]	1.57	500	[illegible]	[illegible]
Chromium	259	0	5	17	[illegible]	5	0.015	563	50.187	12.14	10000	[illegible]	[illegible]
Cobalt	254	0	0	5	0	3	0 048	606	39 147	6 68	219000	2190	26 98
Copper	252	0	1	23	1	7	0.06	3460	220	27.15	130000	[illegible]	[illegible]
Iron	254	0	0	39	0	8	1 5	537000	42110	10468	NV	NV	13006.34
Lead	252	0	24	2	8	2	0.023	240	24.41	7.18	1500	[illegible]	[illegible]
Lithium	253	0	0	6	0	3	0 4	398	39 50	19 36	73000	730	131.27
Manganese	254	0	32	68	8	16	0.06	[illegible]	2681	787	172000	[illegible]	[illegible]
Mercury	246	0	2	11	2	4	[illegible]	[illegible]	0 57	0.14	200	[illegible]	[illegible]
Nickel	260	0	11	31	[illegible]	11	[illegible]	[illegible]	[illegible]	31.48	[illegible]	[illegible]	[illegible]
Selenium	258	0	31	0	[illegible]	0	[illegible]	[illegible]	172	60.8	5000	[illegible]	[illegible]
Silver	251	0	0	9	0	5	0 0025	53 2	3 89	2 03	18300	183	5 95
Strontium	251	0	0	34	0	14	2 5	4670	427	592	2190000	21900	854 79
Thallium*	249	0	1	0	1	0	0.0065	[illegible]	1.04	1.48	[illegible]	[illegible]	[illegible]
Tin	247	0	0	1	0	1	0 24	300	21 36	14 45	2190000	21900	104 54
Vanadium	250	0	2	18	2	4	0.075	[illegible]	[illegible]	18.36	25600	[illegible]	[illegible]
Zinc	252	0	1	24	[illegible]	8	[illegible]	[illegible]	2601	208	1100000	[illegible]	[illegible]
Radionuclides (pCi/L)													
Americium-241	158	0	2	[illegible]	2	3	[illegible]	[illegible]	0.061	0.012	[illegible]	[illegible]	[illegible]
Cesium-137+D	47	0	0	1	0	1	-1 52	0 9492	0 39	0 11	151	1 51	0 78
Plutonium-239/240	163	0	2	11	[illegible]	[illegible]	[illegible]	[illegible]	0.087	0.017	[illegible]	[illegible]	[illegible]
Radium-226+D	77	0	1	20	1	9	[illegible]	[illegible]	5.26	1.20	2000	20	[illegible]

Analyte	Total Number of Samples	Number of Samples Exceeding Tier I AL	Number of Samples Exceeding Tier II AL but less than Tier I AL	Number of Samples Exceeding BG[1] but less than Tier II AL	Number of Wells Exceeding Tier II AL but less than Tier I AL	Number of Wells Exceeding BG but less than Tier II AL	Minimum Conc.	Maximum Conc.	StDev. of Conc.	Average Conc.	Tier I AL	Tier II AL	BG[1]
Radium-228+D	27	0	0	19	0	9	0 2455	14	3 39	2 76	2000	20	0
Strontium-90+D	146	0	18	0	0	9	[illegible]	[illegible]	0.69	[illegible]	[illegible]	[illegible]	[illegible]
Uranium-234*	250	0	49	0	[illegible]	0	[illegible]	[illegible]	[illegible]	4 46	[illegible]	[illegible]	[illegible]
Uranium-235+D*	249	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0 20	[illegible]	[illegible]	[illegible]
Uranium-238+D*	250	2	166	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Organics (ug/L)													
1,1,2,2-Tetrachloroethane	259	0	[illegible]	0	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1,1-Dichloroethene	263	0	[illegible]	0	[illegible]	0	[illegible]	[illegible]	[illegible]	2 05	[illegible]	[illegible]	[illegible]
Methylene chloride	261	0	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Tetrachloroethene	264	0	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Trichloroethene	264	0	[illegible]	[illegible]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Water Quality Parameter (mg/l)													
Sulfate	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Note There were 50 wells sampled in the study area. Analytes shown are those that were detected at least once above background levels and have an Action Level Groundwater samples were analyzed for Target Analyte List (TAL) metals, gross alpha and beta, uranium-233,234, uranium-235, uranium-238, americium-241, plutonium-239,240, and Target Compound List Volatile Organic Compounds, Semi-Volatile Organic Compounds, and Pesticides/PCBs

*Background exceeds the Tier II AL Therefore, for these analytes, the number of samples/wells exceeding BG is correct, but its actually the number exceeding BG but less than the Tier I AL (not Tier II AL), and the number of samples/wells exceeding Tier II AL is correct, but its actually the number exceeding Tier II AL but less than BG (not Tier I AL)

BG - Background

AL - Action Level

NV – No Value

StDev - Standard Deviation

[1] Organic detections estimated or otherwise are considered to be above background concentrations

Above Tier II AL

44

45

Table 4-4
Upstream Woman Creek Surface Water Quality Summary

Analyte	Total Number of Samples	Number of Samples Exceeding BG[1] but less than the AL	Number of Samples Exceeding AL	Number of Stations Exceeding BG but less than the AL	Number of Stations Exceeding the AL	Minimum Conc.	Maximum Conc.	St Dev of Conc.	Average Conc.	BG[1]	AL
Inorganics (ug/L)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Aluminum*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Arsenic*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Beryllium	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Cadmium*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Copper	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Lead*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Mercury*	100	1	4	1	1	0 05	0 44	0 05	0 11	0 41	0 01
Nickel	99	1	0	1	0	1 5	35 9	7 19	7 38	19 87	123
Silver*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Radionuclides (pCi/L)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Americium-241	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Gross Alpha	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Gross Beta*	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Plutonium-239/240	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Tritium	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Uranium-234[2]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Uranium-235+D[2]	60	3		2		-0 02	0 43	0 10	0 05	0 19	NV
Uranium-238+D[2]	62	5		2		0	2 81	0 55	0 44	1 22	NV
Organics (ug/L)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
1,2-Dichloroethane	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
2-Butanone	53	1	0	1	0	5	12	0 96	5 13	NV	21900
Acetone	57	1	0	1	0	1	22	4 07	6 11	NV	3650
bis(2-Ethylhexyl)phthalate	15	1	0	1	0	1	32 5	8 30	7 77	NV	1 8
Carbon disulfide	57	1	0	1	0	2 5	6	0 46	2 56	NV	3650
Carbon tetrachloride	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Methylene chloride	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Analyte	Total Number of Samples	Number of Samples Exceeding BG[1] but less than the AL	Number of Samples Exceeding AL	Number of Stations Exceeding BG but less than the AL	Number of Stations Exceeding the AL	Minimum Conc.	Maximum Conc.	St Dev. of Conc.	Average Conc.	BG[1]	AL
Tetrachloroethene	61	0	1	0	[illegible]	2 5	10	[illegible]	2 62	NV	[illegible]
Toluene	59	2	0	1	0	2 5	12	1 49	2 77	NV	1000
Trichloroethene	61	[illegible]	[illegible]	[illegible]	[illegible]	2 5	[illegible]	[illegible]	2 59	NV	[illegible]
Water Quality Parameters (mg/l)											
Cyanide*	20	1	0	1	0	0 00125	1	0 24	0 08	0 01	0 005
Nitrate (MCL as N)	9	4	0	2	0	0 025	7 3	2 49	1 40	0 04	10

Note Data are for surface water stations SW039, SW040, SW041, and SW506 Analytes shown are those that were detected at least once above background levels and have an Action Level Surface water samples were analyzed for Target Analyte List (TAL) metals, gross alpha and beta, uranium-233,234, uranium-235, uranium-238, americium-241, plutonium-239,240, and Target Compound List Volatile Organic Compounds, Semi-Volatile Organic Compounds, and Pesticides/PCBs

*Background exceeds the AL Therefore, for these analytes, the number of samples/wells exceeding BG is correct, but there is no upper limit on the range, and the number of samples/wells exceeding AL is correct, but its actually the number exceeding AL but less than BG

BG - Background AL - Action Level StDev - Standard Deviation NV – No Value

[1] Organic detections, estimated or otherwise, are considered to be above background concentrations

[2] There is no individual isotope AL The AL for total U is 11 pCi/L for Woman Creek

Above AL

Table 4-5
Downstream Woman Creek Surface Water Quality

Analyte	Total number of samples	Number of Samples Exceeding BG[1] but less than the AL	Number of Samples Exceeding AL	Number of Stations Exceeding BG but less than the AL	Number of Stations Exceeding the AL	Minimum Conc.	Maximum Conc.	St Dev. of Conc.	Average Conc.	BG	AL
Inorganics (ug/l)											
Aluminum*	170	[illegible]	39	2	[illegible]	[illegible]	24800	[illegible]	[illegible]	[illegible]	[illegible]
Antimony*	165	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8.29	18.30	[illegible]	[illegible]
Arsenic*	173	0	5	0	2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Beryllium	162	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	7.61	4.53	2.34	[illegible]
Cadmium*	167	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Copper	163	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	309	[illegible]	5.10	[illegible]	[illegible]
Lead*	170	[illegible]	6	0	[illegible]	[illegible]	[illegible]	5.72	1.69	6.58	[illegible]
Mercury*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.09	[illegible]	[illegible]	[illegible]
Selenium*	168	0	[illegible]	0	2	[illegible]	[illegible]	2.13	[illegible]	[illegible]	[illegible]
Silver*	172	2	[illegible]	[illegible]	3	[illegible]	[illegible]	1.45	2.29	3.91	[illegible]
Thallium*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.80	1.60	6.08	[illegible]
Zinc*	164	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	15.29	[illegible]
Radionuclides (pCi/l)											
Americium-241	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.09	0.03	0.02	[illegible]
Gross Alpha	110	0	[illegible]	0	[illegible]	[illegible]	[illegible]	1.84	1.44	5.99	[illegible]
Gross Beta*	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	[illegible]	5.40	3.62	15.59	8
Plutonium-239/240	118	10	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.07	0.02	0.02	[illegible]
Uranium-234[2]	97	9	0	3	0	-0 06	7 98	1 21	0 75	1 59	NV
Uranium-235+D[2]	105	4	0	2	0	-0 2	0 74	0 11	0 04	0 19	NV
Uranium-238+D[2]	113	9	0	3	0	-0 05	7 08	0 90	0 53	1 22	NV
Organics (ug/l)											
1,2-Dichloroethane	106	0	2	[illegible]	1	[illegible]	[illegible]	1.61	2.66	NV	[illegible]
Acetone	89	1	0	1	0	1	28 5	3 78	5 58	NV	3650
Methylene chloride	104	1	3	1	1	[illegible]	20	2.52	2.94	NV	[illegible]
n-Nitrosodiphenylamine	30	2	0	2	0	1	8	1 45	4 95	NV	5
Toluene	104	1	0	1	0	0.25	12	1 00	2 53	NV	1000
Toxaphene	29	0	1	0	1	[illegible]	[illegible]	0.10	0.54	NV	0.0002

Analyte	Total number of samples	Number of Samples Exceeding BG[1] but less than the AL	Number of Samples Exceeding AL	Number of Stations Exceeding BG but less than the AL	Number of Stations Exceeding the AL	Minimum Conc.	Maximum Conc.	St Dev. of Conc.	Average Conc.	BG	AL
Trichloroethene	106	9	0	[illegible]	1	[illegible]	5	2 31	2 67	NV	[illegible]
Vinyl acetate[3]	99	1	0	1	0	2	5	0 30	4 97	NV	NV
Xylenes	105	1	0	1	0	0 25	2 5	0 35	2 43	NV	10000
Water Quality Parameters (mg/L)											
Cyanide	38	1	0	1	0	0 001	0 5	0 08	0 02	0 01	0 005
Nitrate (MCL as N)	26	9	0	3	0	0 025	11 0675	2 97	0 98	0 04	10

Note Data are for surface water stations SW032, SW033, SW034, SW10295, SW50193, and SW50293 Analytes shown are those that were detected at least once above background levels and have an Action Level Surface water samples were analyzed for Target Analyte List (TAL) metals, gross alpha and beta, uranium-233,234, uranium-235, uranium-238, americium-241, plutonium-239,240, and Target Compound List Volatile Organic Compounds, Semi-Volatile Organic Compounds, and Pesticides/PCBs

*Background exceeds the AL Therefore, for these analytes, the number of samples/wells exceeding BG is correct, but there is no upper limit on the range, and the number of samples/wells exceeding AL is correct, but its actually the number exceeding AL but less than BG

BG - Background AL - Action Level St Dev - Standard Deviation NV – No Value

[1] Organic detections, estimated or otherwise, are considered to be above background concentrations
[2] There is no individual U isotope AL The AL for total U is 11 pCi/L for Woman Creek
[3] There is no AL for vinyl acetate
Above AL

Table 4-6
South Interceptor Ditch Surface Water Quality Summary

Analyte	Total number of samples	Number of Samples Exceeding BG[1] but less than the AL	Number of Samples Exceeding AL	Number of Stations Exceeding BG but less than the AL	Number of Stations Exceeding the AL	Minimum Conc.	Maximum Conc.	St Dev. of Conc.	Average Conc.	BG[1]	AL
Inorganics (ug/L)											
Aluminum*	115	[illegible]	32	1	[illegible]	[illegible]	2600	1046 89	1598 62	[illegible]	[illegible]
Antimony*	[illegible]	[illegible]	[illegible]	[illegible]	2	[illegible]	[illegible]	7 90	11 41	[illegible]	[illegible]
Arsenic*	109	1	[illegible]	[illegible]	3	[illegible]	[illegible]	1 27	1 19	[illegible]	[illegible]
Barium	107	3	1	[illegible]	[illegible]	[illegible]	[illegible]	104 38	128 10	126 88	[illegible]
Beryllium	[illegible]	0	[illegible]	0	[illegible]	[illegible]	[illegible]	0 89	[illegible]	[illegible]	[illegible]
Cadmium*	110	1	[illegible]	[illegible]	2	[illegible]	[illegible]	0 84	1 48	[illegible]	[illegible]
Copper	114	0	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lead*	115	0	[illegible]	0	[illegible]	[illegible]	[illegible]	10 30	2 90	[illegible]	[illegible]
Mercury*	107	[illegible]	6	2	[illegible]	[illegible]	[illegible]	0 24	0 14	[illegible]	[illegible]
Nickel	109	3	0	1	0	0 5	105	12 57	7 26	19 87	123
Selenium*	113	0	[illegible]	0	[illegible]	[illegible]	[illegible]	1 93	1 18	[illegible]	[illegible]
Silver*	[illegible]	[illegible]	[illegible]	[illegible]	3	[illegible]	[illegible]	[illegible]	2 16	[illegible]	[illegible]
Thallium*	108	0	2	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Zinc*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Radionuclides (pCi/L)											
Americium-241	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0 03	0 02	[illegible]
Gross Alpha	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8 70	7 72	[illegible]	[illegible]
Gross Beta*	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9 84	[illegible]	[illegible]	[illegible]
Plutonium-239/240	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0 03	0 02	[illegible]
Tritium	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Uranium-234	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Uranium-235+D	70	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0 17	0 19	[illegible]
Uranium-238+D	70	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Organics (ug/L)											
2-Butanone	48	1	0	1	0	1 5	12	1 14	5 07	-	21900
Acetone	49	3	0	2	0	4 5	210	29 28	9 54	-	3650
bis(2-Ethylhexyl)phthalate	[illegible]	0	[illegible]	0	[illegible]	[illegible]	100	2 09	4 98	[illegible]	[illegible]

Analyte	Total number of samples	Number of Samples Exceeding BG[1] but less than the AL	Number of Samples Exceeding AL	Number of Stations Exceeding BG but less than the AL	Number of Stations Exceeding the AL	Minimum Conc.	Maximum Conc.	StDev of Conc.	Average Conc.	BG[1]	AL
Diethyl phthalate	22	1	0	1	0	4	10	1 50	5 43	-	5600
Methylene chloride	56	2	0	2	0	0 5	10	1 66	2 91	-	4 7
Trichloroethene	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Water Quality Parameters (mg/L)											
Nitrate (MCL as N)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Note Data are for surface water stations SW036, SW038, SW129, and SW500 Analytes shown are those that were detected at least once above background levels and have an Action Level Surface water samples were analyzed for Target Analyte List (TAL) metals, gross alpha and beta, uranium-233,234, uranium-235, uranium-238, americium-241, plutonium-239,240, and Target Compound List Volatile Organic Compounds, Semi-Volatile Organic Compounds, and Pesticides/PCBs

*Background exceeds the AL Therefore, for these analytes, the number of samples/wells exceeding BG is correct, but there is no upper limit on the range, and the number of samples/wells exceeding AL is correct, but its actually the number exceeding AL but less than BG

BG - Background AL - Action Level StDev - Standard Deviation NV-No Value

[1] Organic detections, estimated or otherwise, are considered to be above background concentrations

[2] There is no individual U isotope AL The AL for total U is 11 pCI/L for Woman Creek

Above AL

Figure 4-6
Selenium Concentrations in Well 7086

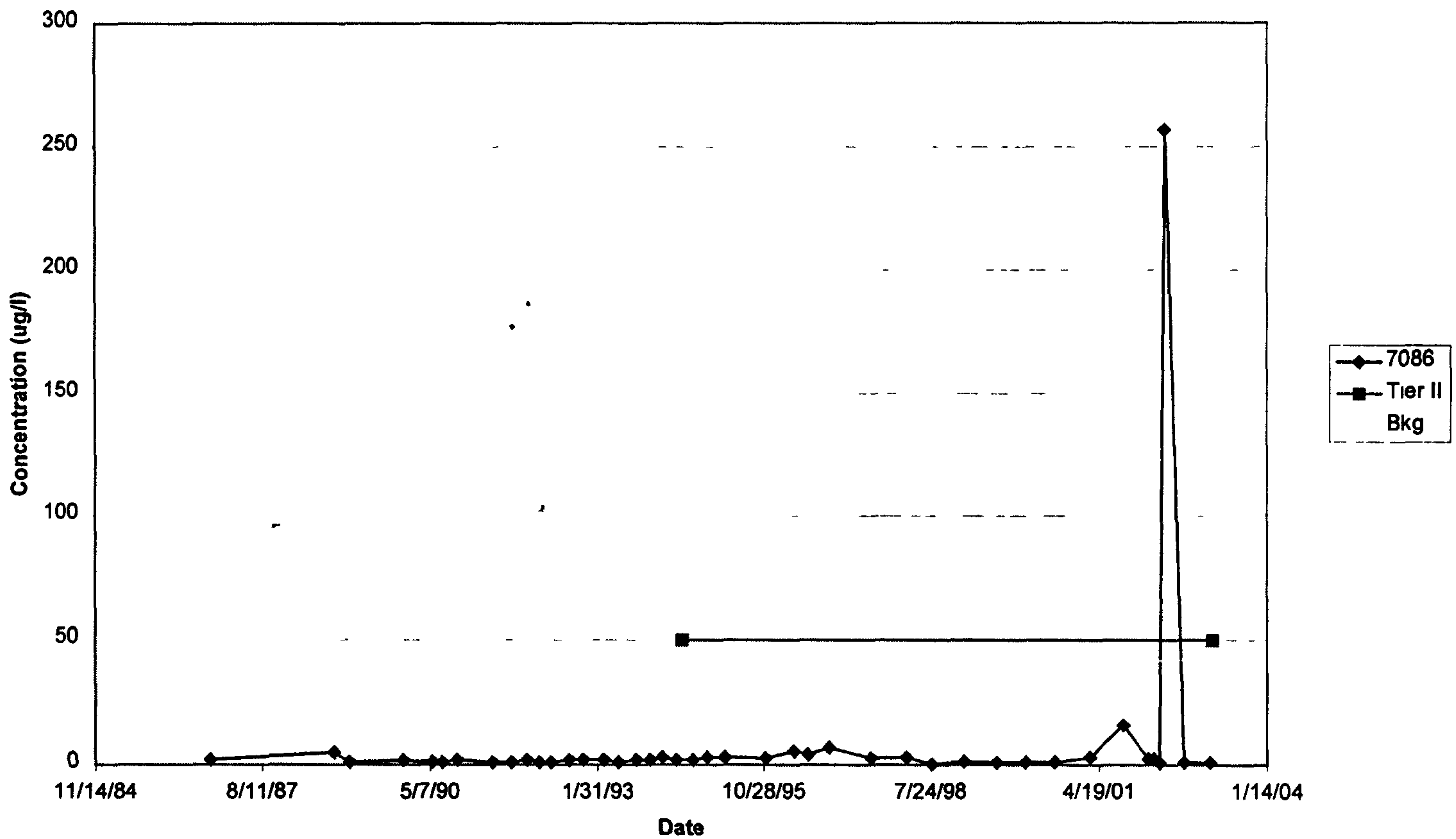

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Figure 4-7
Selenium Concentrations in Well 10994

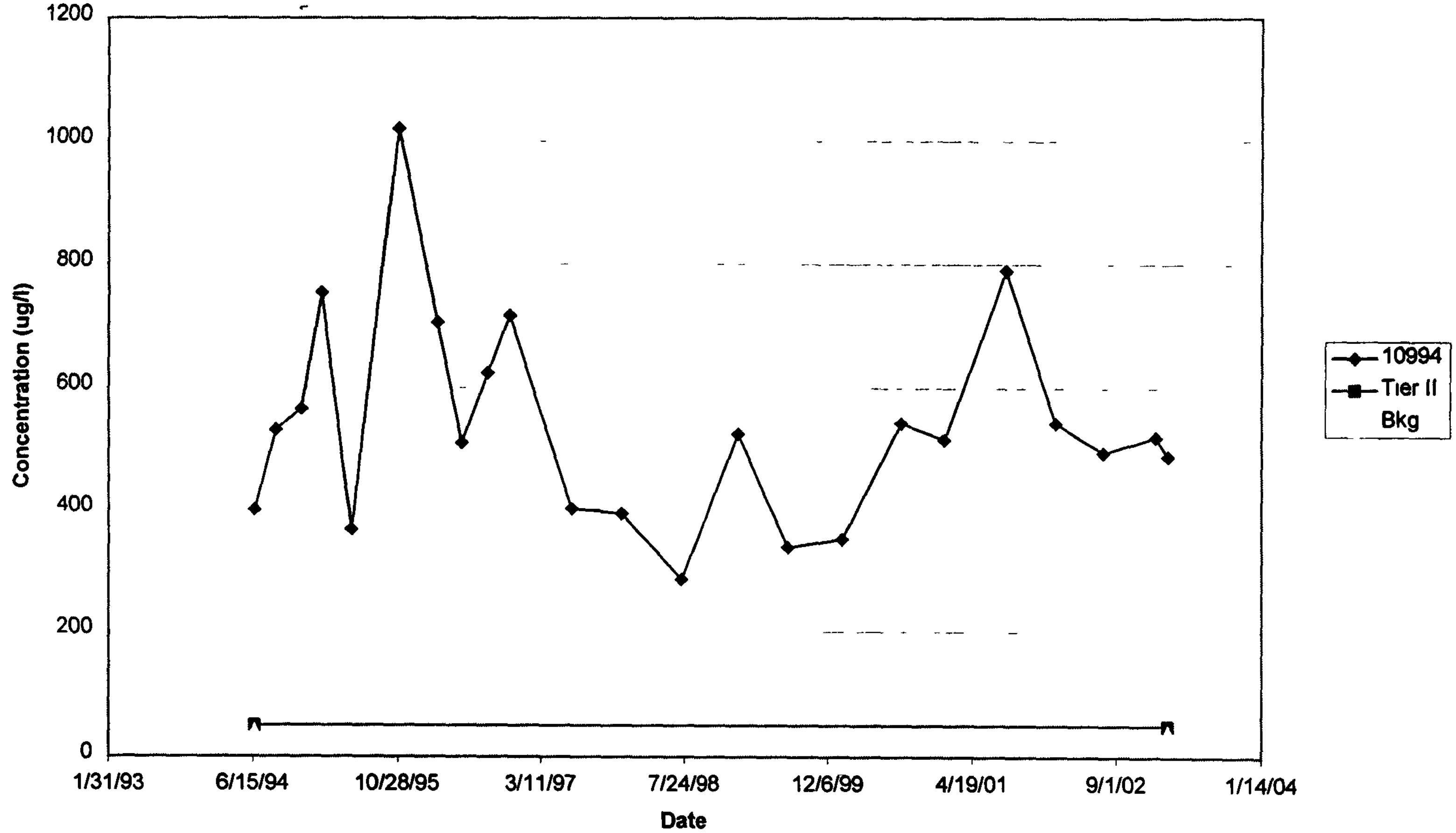
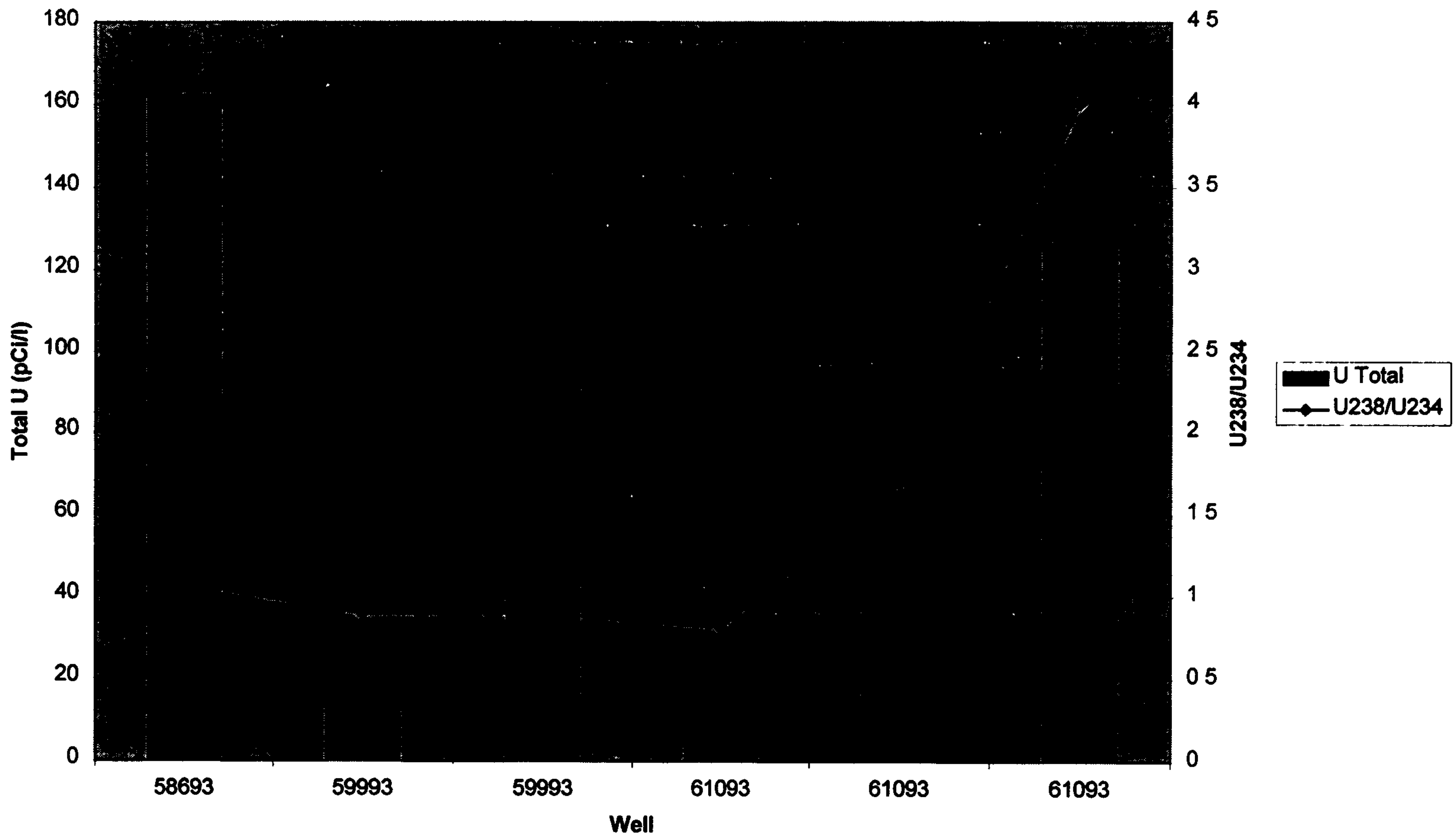


Figure 4-9
Total Uranium Concentrations and Uranium Isotopic Ratios in Groundwater



65

Figure 4-11
TCE Concentrations in Groundwater

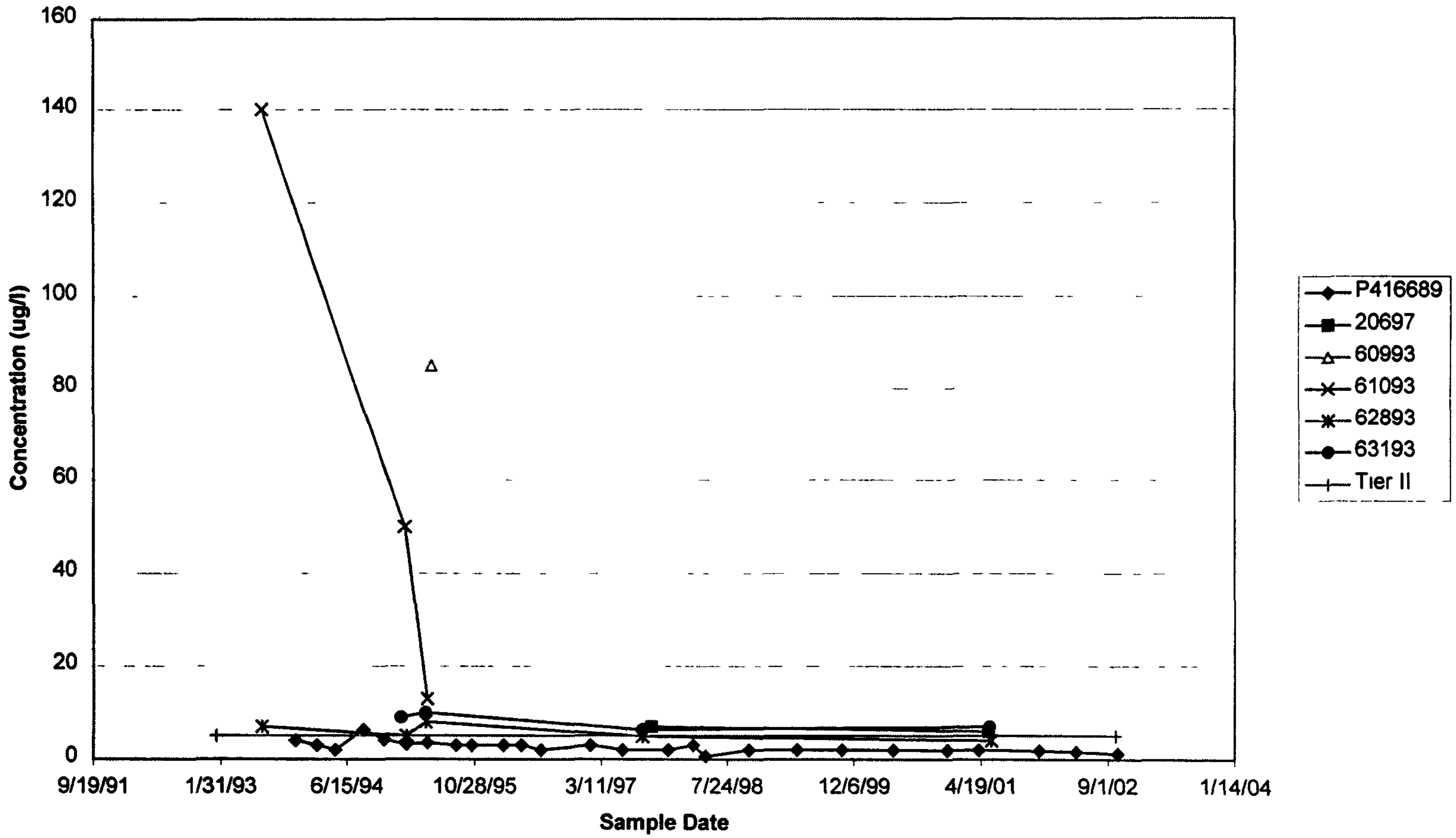


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Figure 4-12
Selenium Concentrations in Downgradient Woman Creek Surface Water

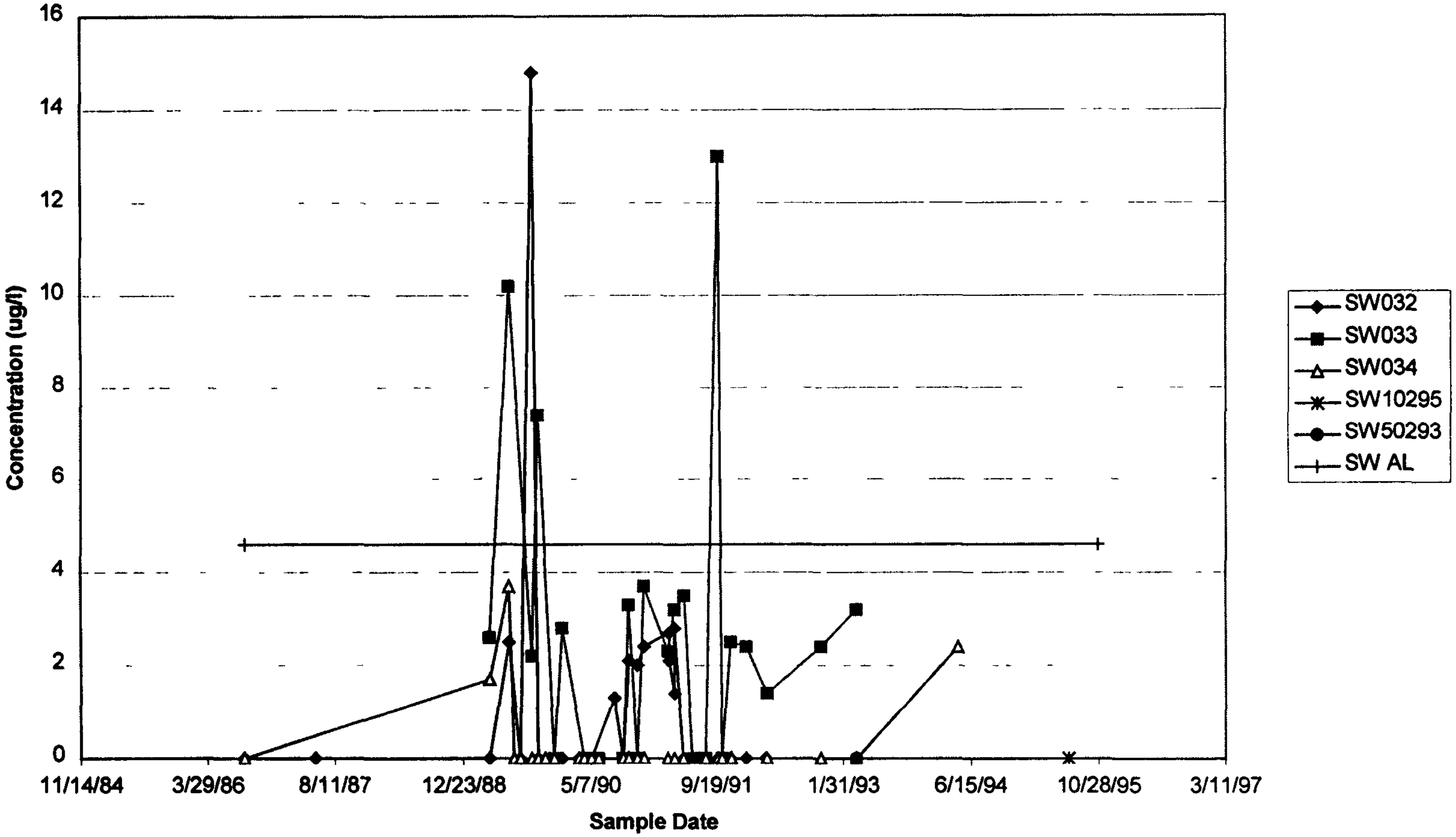
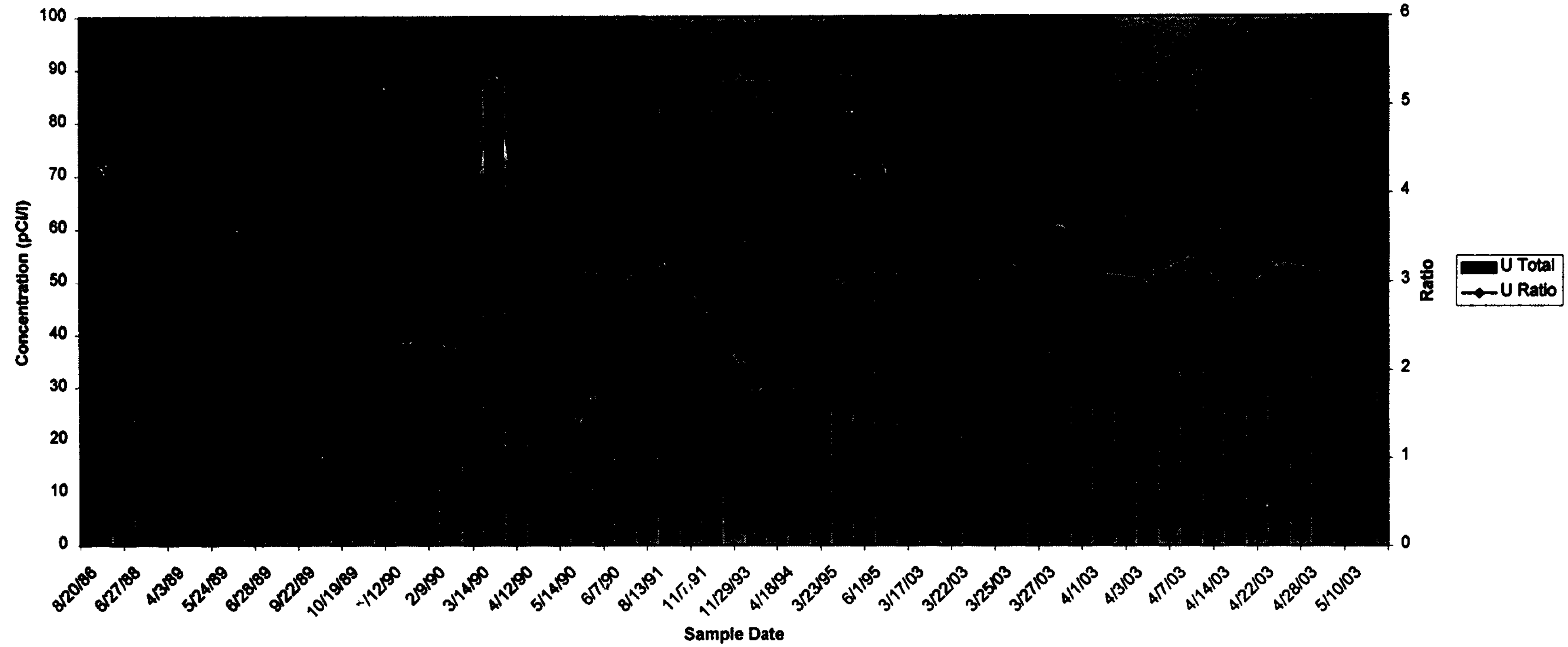


Figure 4-13
Total Uranium Concentrations and Uranium Isotopic Ratios for Surface Water at SW-36



5.0 REMEDIAL ACTION OBJECTIVES

Based upon an evaluation of the OLF operation and the waste types and the risks posed by exposure pathways from the OLF, an accelerated action consistent with the municipal and military landfill presumptive remedy of source containment after hot spot removal is appropriate for the OLF The streamlining features for evaluating the contamination source and the baseline risks posed to human and ecological health afforded by the landfill presumptive remedy directives have been meet by the conduct of the OU-5 Phase I RFI/RI (Kaiser-Hill 1996) However, the information obtained by the investigation process and subsequent monitoring substantiates the application of specific source containment components necessary to address the OLF exposure pathways

The guidance in the *Application of the CERCA Municipal Landfill Presumptive Remedy to Military Landfills,* OSWER Directive No 9355 0-67FS, December 1996, was used to evaluate the characteristics of the OLF in relation to those that affect application of the source containment remedy The following characteristics are consistent with the relevant guidance for the presumptive remedy

- Risks are low level, except for uranium surface hot spots,
- Treatment of waste is impractical due to the volume and heterogeneity of waste,
- Waste types include household, commercial (e g , construction debris), non-hazardous sludge, and industrial solid wastes (e g , process wastes, volatile organic compounds, paints), and
- Small amounts of wastes with hazardous constituents were disposed (and the amounts appear small as compared to municipal waste)

The guidance notes that some military facilities (e g , weapons fabrication and testing) have a high level of industrial activity compared to overall site activities such that there may be a higher proportion and wider distribution of industrial wastes than for less industrialized facilities The guidance also notes that some wastes specific to military landfills (e g , low-level radioactive wastes) so long as they are not predominant, can be considered low-hazard and no more hazardous that some waste found in municipal landfills Other military wastes such as munitions, chemical warfare agents and chemicals are high hazard wastes and require special consideration These types of wastes were not disposed in the OLF

As described in OU-5 Phase I RFI/RI Report and sections 2 0 and 4 0 of this IM/IRA, the types of wastes, levels of contamination and risks posed by the OLF are similar to those deemed appropriate to implement a presumptive source containment remedy It is also important to note that the OLF has been closed for approximately 35 years with an inadequate soil cap and very little maintenance or controls applied, and the levels and extent of contamination in environmental media are quite low

Some surface and subsurface soil sample show contamination above specific Soil Action Levels in *RFETS Action Levels and Standards Framework for Surface Water, Ground Water and Soils*, RFCA Attachment 5 (ALF), Table 3, Soil Action Levels ALF Sections 4 0 and 5 0 require removal of contaminated surface soils to depths specified for non-radioactive and radioactive contaminants At the OLF, these areas are surface soil hot spots that will be removed after approval of this IM/IRA in accordance with the *Environmental Restoration RFCA Standard Operating Protocol for Routine Soil Remediation* (DOE 2003)

Deeper soils that are contaminated above soil action levels must be evaluated in accordance with the ALF Figure 3, *Subsurface Soil Risk Screen* and ALF Section 4 2 and 5 3 to determine whether an action is required For convenience, ALF Figure 3 is shown in Figure 5 1 Since soils action levels are exceeded, the OLF fails Screen 1 Since the OLF lies in an erosion area and the waste and commingled soil has become exposed to the surface, the OLF also fails Screen 2 It is assumed that some subsurface soils may exceed soil action levels for depleted uranium, particularly below the surface hot spots, and is is also assumed that the OLF fails Screen 3 Under Screen 4, it appears that the uranium contamination found at SW-036 could be caused at least in part by surface run off into the SID While this sampling point is not an ALF Section 2 surface water Point of Compliance or Point of Evaluation, an accelerated action evaluated under Screens 2 and 3 should adequately address this potential contaminant source For Screen 5, the baseline Ecological Risk Assessment for the Woman Creek Priority Drainage discussed in section 4 7 of this IM/IRA concluded that there is not an unacceptable risk to ecological receptors Additional ecological action levels are being developed and ecological risks will be evaluated in the Accelerated Ecological Screening Process and in the Comprehensive Risk Assessment

The OU 5 Phase I RFI/RI concluded that the OLF does not generate hazardous concentrations of landfill gas, so no gas collection or treatment action is required

Ground water at the OLF does contain concentrations for some organic compounds and some metals, including depleted uranium greater than background and ALF Table 2, Action Levels for Groundwater However, this contamination does not generate an expanding plume of groundwater contamination outside of the OLF source area and does not adversely impact surface water quality or present an exposure pathway outside of the OLF source area In accordance with ALF, Section 3 3 C 2, groundwater plumes that can be shown to be stationary and do not therefore present a risk to surface water, regardless of their contaminant levels, will not require mitigation or management. They will require continued monitoring to demonstrate that they remain stationary Ground water at the OLF is not a drinking water source and could not sustain any prolonged use, such as a drinking water use

Based upon the foregoing evaluation, the risks posed by the OLF will be addressed by the proposed accelerated action The proposed action is to implement the presumptive remedy of source containment. There are two pathways of exposure to be addressed by source containment

- direct exposure to disposed waste and commingled soil, and

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- surface erosion and runoff of contaminants into surface water

The components of the source containment remedy that are necessary to address these pathways are

- a landfill cap to prevent direct contact with landfill soil or debris,
- the landfill cap must also adequately control erosion caused by water run on and run off, and
- institutional controls to supplement the engineering controls to appropriately monitor and maintain the remedy

In addition to these components, ground water and surface water monitoring will be done to evaluate whether contamination is potentially migrating from the source area and creating a path of exposure through surface water Additional evaluation and description of the presumptive remedy components and consideration of alternatives is presented in sections 6 0 through 10 0

6.0 REMEDIAL ACTION ALTERNATIVES EVALUATION

This section describes the remedial action alternatives considered for the Original Landfill and Filter Backwash Pond, Individual Hazardous Substance Site (IHSS) 115/196, and presents a comparative analysis of the alternatives in accordance with CERCLA guidelines, the remedial action objectives, and ARARs

6.1 Remedial Action Alternatives

This section presents three remedial action alternatives for the Original Landfill The alternatives include the options of leaving the waste in an undisturbed state, leaving the majority of the waste in place with a protective cover, and total removal

6.1.1 Alternative 1 – No Action

Alternative 1 minimizes human exposure to contaminants remaining at the site by limiting access to the Original Landfill All waste would be left in place as they are today and site features, such as Woman Creek and the South Interceptor Ditch (SID), would not be disturbed The Preble's Meadow Jumping Mouse (PMJM) protection area would also not be disturbed Since waste would be left in place, institutional controls and site monitoring are considered part of this alternative.

Institutional Controls

Institutional controls would be used at the site to provide short- and long-term protection of human health and the environment Institutional controls include administrative and/or legal controls that minimize the potential for human exposure to contamination by limiting land or resource use Land use restrictions would be required to restrict use of the area In addition, advisories, or warnings that provide notice to potential users of land, surface water or groundwater would be necessary

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Site Monitoring

The current conditions of surface water, groundwater and soil erosion at the OLF would be monitored to track any changes that might result in an adverse condition Monitoring would be instituted through the current RFETS Integrated Monitoring Program (IMP) and ultimately in sitewide post-closure regulatory documents Additional monitoring wells could be installed, if needed, to provide sufficient coverage to monitor changes is groundwater quality In addition, an annual inspection of the area would be conducted to identify any visual changes at the Original Landfill An annual ground topographic survey would be completed to monitor slope stability

6.1.2 Alternative 2 – Soil Cover

This alternative consists of the removal of surface soil "hot spots," clearing and grubbing of the landfill area, limited area grading, and implementing the presumptive remedy by placement of a soil cover, cover re-vegetation, monitoring, and institutional controls

Removal of Surface Soil Contaminants

The contaminants exceeding soil action levels are discussed in Section 4 3

The surface soil hot spots would be removed prior to all other activities at the site to enhance worker safety All surface soil with concentrations above the soil action levels would be removed as shown on Figure 4-2 It is estimated that the volume of soil meeting this criterion is less than 400 cubic yards The procedures for removing and disposing of the soil are described below

Surface Soil Removal and Disposal

Surface soil will be stripped to a depth of 6-inches using standard soil excavation equipment The equipment would be used to move the contaminated surface soil to waste containers near the excavation The contaminated soil would then be managed per RFETS procedures and transported to an appropriately permitted and/or licensed facility for final disposal

Control measures would be implemented during this activity to control the spread and release of contamination The control measures would include the establishment of work zones, decontamination procedures, dust suppression methods, traction mats, visual inspections, and radiological surveys Work would be suspended when environmental conditions such as during high winds that greatly increase the possibility of the spread of contaminated materials Monitoring would be performed, as necessary, to verify that there has been no release of contaminated materials

Confirmation Sampling

Excavated areas would be carefully monitored with appropriate field screening devices and laboratory analyses to determine the outer limits of the contaminated surface soil areas Field screening using standard RFETS instrumentation would be used to verification the depth and extent of excavation to below the action levels (e g , NE

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Electra, micro-R, Ludlum 12, HPGE) Confirmation soil samples would be taken for final isotopic analysis Following the confirmation samples, non-impacted soils from locations adjacent to the excavated areas would be moved to reduce surface slopes and to blend excavated areas into the surrounding surfaces prior to the action for the entire Original Landfill

Area Grading & Soil Cover

The waste fill area would be graded to a constant 18 percent (5 5 1) slope angle using a cut and fill approach that is as balanced as possible Standard earth-moving equipment, such as dozers, hoes or scrapers, would be used to cut the areas where the slope exceeds the desired 18 percent and to fill the areas where the slope is less than the desired 18 percent slope It is estimated that approximately 70,000 cubic yards of waste fill material would be moved during the process

Control measures would be implemented during the grading process to control the spread and release of waste materials in the Original Landfill The control measures would include the establishment of work zones, decontamination procedures, dust suppression methods, traction mats, visual inspections, and radiological surveys Work would be suspended when environmental conditions could greatly increase the possibility of the spread of contaminated materials Monitoring would be performed, as necessary, to verify that there has been no release of contaminated materials

After the grading of the landfill surface is complete, a soil cover will be placed over the landfill to a minimum thickness of 2 feet About 65,000 cubic yards of local or onsite soil will be used to construct the cover The soil cover will be compacted sufficiently to provide a stable cover system to promote surface water runoff, reduce surface water ponding, and increase overall slope stability

Revegetation of the soil cover with native species will reduce infiltration and control erosion The seeding will be conducted along with erosion control matting or mulch to prevent erosion of the cover while allowing the vegetation to establish a strong stand

The following plant properties will ensure healthy, productive, and long-term vegetative growth on the landfill cover

- Locally-adapted, non-invasive or native species able to withstand Front Range drought and temperature extremes will be used as vegetative cover

- Long-term fertilization and nutrient supplements are not planned at this time, therefore, it is critical that the vegetation be able to survive under existing soil conditions Native grasses and forbs will thrive with little maintenance Soil amendments may be provided to supplement borrow material to establish initial vegetation on the cover

- Both cool and warm season species will be planted to provide transpiration throughout as much of the year as possible Locally-adapted species of grasses

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and forbs normally transpire all available water in semi-arid climates, such as that at RFETS

- A strong stand of vegetation will limit cover erosion from both wind and water

A draft seed mix will be developed during the design in consultation with U S Fish and Wildlife Service (Service) and the RFETS Ecology Group

Possible Alternative Features

As presented in Section 2 6, the stability of the slopes at the present landfill is uncertain, however, there are currently no indications of subsurface movement of the landfill since there is no evidence of surface separations To assure cap and landfill stability, the design of the remedial action will be based on an accurate topographic survey and a limited and focused geotechnical investigation The geotechnical investigation will use the past geotechnical assessments as a resource to determine the scope of this additional investigation The purpose of the geotechnical investigation is to provide engineering information relevant to the final grading and cover stability and will

- Assess the stability of the underlying soil and bedrock with the configuration of the limited grading and cover alternative,
- Assess the impact of groundwater on the underlying soil and bedrock stability with the configuration of the limited and grading cover alternative, and
- Collect the needed geotechnical information to design a long term, landfill stability monitoring plan

This geotechnical investigation will also determine if a retaining wall is needed at the toe of the landfill slope and/or a groundwater barrier is needed upgradient of the landfill to promote structural stability The results of the geotechnical investigation will be available to the CDPHE, EPA and stakeholders for the transfer to landfill technical information

Institutional Controls

Post-accelerated action institutional controls will be implemented These controls consist of access controls, continued DOE jurisdiction, and controls to prevent drilling, excavation or disruption of the cap or sampling stations Routine monitoring and inspection of implemented controls will be performed

6.1.3 Alternative 3 – Removal of Waste

The objective of this alternative is to remove the entire waste fill from within the OLF area and restore the hill slope The remedial measures would consist of the following five activities

- Preparation of the site,

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- Excavation of contaminated debris and soils,
- Characterization and segregation of waste fill debris and soil,
- Offsite disposal of waste fill debris and contaminated soil, and
- Restoration of disturbed areas

It is estimated that approximately 192,000 cubic yards of waste fill debris and soil would be excavated, characterized, and transported to an off site, licensed disposal facility The volumes of radioactive and non-radioactive contamination in the waste fill are currently unknown, but would be determined during implementation These remedial measures would be completed in approximately 3 years Specific activities to implement this alternative are described below

Site Preparation

Prior to excavation of the waste fill debris and soil, the site would be prepared First, access roads and storage areas would be constructed Second, the area to be excavated would be cleared and grubbed, and surface water control features would be constructed The procedures used to complete these tasks are described below

Construction of Storage Areas and Access Roads

A storage area would be located north of the OLF boundary It is estimated that three to four acres would be required to accommodate the required equipment, supplies, and construction offices to stage and characterize the removed waste materials and soils

In addition, this alternative would require the construction of three new access roads The first new access road would be constructed to connect the existing access road that runs east-west through the center of the OLF to the waste fill area that is located in the northeast section of the landfill The second new access road would be located south of the OLF boundary to connect the existing access road to the waste fill area that is located in the southern section of the landfill The third new access road would be located on the western edge of the OLF boundary to connect the existing access road to the stockpile area The combined length of these new access roads would be approximately 2000 ft. The maximum grade of the new roads would not exceed 7 percent, and the design would allow for drainage of surface waters while the roads were in use

Clearing, Grubbing, and Stockpiling

A stockpile area would be located on the terrace just northwest of the IHSS boundary It would be approximately two acres in size and would accommodate up to 20,000 cubic yards of waste fill material at any given time during the project

The area within the OLF boundary would be cleared and grubbed of vegetation, debris, loose rocks, and other items that would interfere with the waste fill removal process. The cleared materials would be transported to the stockpile area for characterization prior to disposal The surface water would be directed around the stockpile and excavated areas

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Excavation of Contaminated Waste Fill Debris and Soils

The area that would be excavated ıs shown on Fıgure 1-2 The waste fill wıthın thıs area would be strıpped and placed ınto temporary stockpıles usıng standard equıpment such as crawler-type dozers, track-type loaders, and track-mounted excavators The machınes utılızed would be small enough to ensure a hıgh degree of cut accuracy and a mınımum amount of over excavatıon Trucks or large capacıty wheel loaders would be used to move the waste fill from temporary stockpıles to the prımary stockpıle area located just northwest of the OLF boundary

Excavated areas would be carefully ınspected vısually and wıth field ınstrumentatıon to determıne the outer lımıts of the waste fill area Then confirmatıon samplıng and analysıs would be conducted to verıfy that radıoactıve and non-radıoactıve waste materıals have been adequately removed

Characterizatıon of Waste Fill Debrıs and Soil

The waste fill materıal removed from the OLF durıng the grubbıng and excavatıon processes would be characterızed at the stockpıle area usıng a two-step process Fırst, field screenıng technıques would be used to determıne ıf the transuranıc content of the stockpıled materıal ıs greater or less than 10 nanocurıes/gram Second, samples would be collected and analyzed to determıne ıf the materıal ıs a characterıstıc RCRA hazardous waste Potentıal hazardous waste would be further characterızed usıng the Envıronmental Protectıon Agency (EPA) TCLP analysıs

Dısposal of Waste Fill Debris and Soıl

Followıng characterızatıon, each pıle of waste fill materıal would be classıfied for dısposal Items determıned to be radıologıcally contamınated or that exhıbıt a toxıcıty characterıstıc would be transported to an approprıately lıcensed facılıty for final dısposal Items determıned not to be radıologıcally contamınated or that do not exhıbıt a toxıcıty characterıstıc would be managed as solıd waste Waste materıal classıfied as solıd waste and meetıng dısposal facılıty waste acceptance crıterıa, would be dısposed of at a local sanıtary landfill

Restoratıon of Disturbed Areas

Followıng completıon of remedıatıon actıvıtıes, the dısturbed areas would be reclaımed Thıs process would requıre some gradıng and backfillıng of the area prıor to seedıng and revegetatıon The seedıng and revegetatıon process would be the same as descrıbed ın Sectıon 6 1 2

6.2 COMPARATIVE EVALUATION OF ALTERNATIVES

Thıs sectıon provıdes a comparatıve evaluatıon of the remedıal alternatıves usıng the crıterıa of effectıveness, ımplementabılıty, and relatıve cost A summary of the comparatıve evaluatıon ıs provıded ın Table 6-1

The relatıve cost estımates provıded ın thıs report are prelımınary, and are provıded prımarıly for the purpose for the comparıson of varıous remedıal actıon alternatıves wıth each other The final actual costs of a remedıal alternatıve wıll depend upon the labor

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and material costs, site conditions, productivity, and competitive market conditions for contractors at the time of implementation, as well as the final project scope, final project schedule, final engineering design, and other variable factors As a result of these uncertainties, the final costs will vary from the estimates made herein

Estimated costs of the alternatives include indirect capital costs, direct capital costs, and annual costs Estimated costs were prepared utilizing estimated volumes, vendor quotes, available literature, Means Cost Data guides (R S Means Company 2001), and other sources deemed appropriate A more detailed cost analysis may be required for funding purposes In addition, RFETS costs for project management, oversight, and contracting are not included in the cost estimate

6.2.1 Alternative 1 – No Action

This alternative as presented in Section 6 1 1 consists of only institutional controls and monitoring

Effectiveness

Effectiveness considers whether the alternative provides protection of human health and the environment, and achieves the remedial objectives

Protectiveness

Alternative 1 would provide a low level of protection of public health and the environment No action would leave the waste in place as it exists today and allow for potential release of contaminants Alternative 1 would not attain all Applicable and Relevant and Appropriate Requirements (ARARs) Institutional controls, such as fences and signs would help to reduce human exposure to the waste materials However, wildlife workers and trespassers may occasionally enter the restricted area and if erosive processes continue to expose contaminated material, they would potentially be exposed In the short-term, there would be low risks to the workers and public during the implementation of this alternative, and no impact on the Preble's Meadow Jumping Mouse habitat south of the OLF or to wetlands within the Original Landfill

Alternative 1 would not be effective in the long-term Leaving the waste in place would not provide any long-term protection of humans or the environment Institutional controls and monitoring could provide for some protection, although the monitoring is already implemented at the site through an ongoing program The potential for erosion remains providing the possibility of a release of contaminants to Woman Creek

Achieve Remedial Objectives

Alternative 1 would not comply with remedial objectives Under the no action alternative, contamination above action levels in surface soil would remain, and direct exposure to wastes would not be controlled

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Implementability

Implementability addresses the technical and administrative feasibility of implementing an alternative of the required equipment, services and materials

Technical Feasibility

Alternative 1 is technically feasible since no construction activities would be required except for the fabrication and installation of signs and fencing However, alternative 1 would most likely include a high level of monitoring to provide some long-term protection to the public and the environment Maintenance of institutional controls implemented would be considered minimal

Availability

Alternative 1 would only require materials for signs and fencing to implement institutional controls These materials are readily available Monitoring would use industry standard equipment and materials that are also readily available

Administrative Feasibility

The implementation of Alternative 1 does not require permits or easements, and does not impact adjoining property It will not inhibit the ability to impose institutional controls Existing site management and access controls would be maintained until a comprehensive final plan is implemented in the future The alternative is generally consistent with the aesthetic qualities of the facility end use as a wildlife refuge

Alternative 1 would most likely not meet CDPHE, EPA, and community acceptance The No Action alternative would leave waste in place, leading to potential exposure of the public and wildlife and harm to the environment Institutional controls and monitoring would not reduce the hazards on a long-term basis

Cost

Evaluation of costs should consider the capital costs to engineer, procure and construct the required equipment and facilities, and the operating and maintenance costs associated with the alternative

Capital Cost

The capital cost to implement Alternative 1 is between $100,000 and $250,000

Operation & Maintenance Cost

The operation and maintenance costs associated with this alternative involve the inspection of the OLF surface and maintenance of the groundwater and surface water monitoring stations Sampling and analysis of groundwater and surface water is also included Operation and maintenance costs are estimated to be about

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$15,000 per year, however, additional costs could be incurred to address any hazards by the wastes continuing to be exposed

Summary – Alternative 1

Alternative not retained for further consideration because none of the remedial action objectives are met with this alternative

6.2.2 Alternative 2 – Soil Cover

Alternative 2, Soil Cover is presented in Section 6 1 2 and generally includes the removal of radiologically contaminated surface soils, limited site grading, placement of a 2-foot thick soil cover and revegetation of the soil cover

Effectiveness

Effectiveness considers whether the alternative provides protection of human health and the environment, and achieves the remedial objectives

Protectiveness

Alternative 2 would provide a higher overall level of protection than Alternative 1 because the waste would be covered in a manner that more aggressively isolates it from the public and the environment Alternative 2 would comply with ARARs Direct contact with radioactive materials and wastes would be eliminated through the removal of contaminated surface soils The stabilization of the hillside would add additional long-term protection of the waste fill area by reducing the possibility of movement and erosion Potential worker exposure to radioactively and non-radioactively contaminated substances would be higher during implementation of Alternative 2 than during Alternative 1 because the waste would be re-graded during stabilization of the hill slope. Construction of the soil cover would prevent direct human and ecological exposure to the remaining waste fill Stabilization of the hill slope and construction of the soil cover would minimize release of the radioactive and non-radioactive contamination from the Original Landfill

Alternative 2 would provide a high level of long-term effectiveness because the waste fill would be covered with an appropriately designed soil cover Alternative 2 would rely upon proven technologies for slope stabilization and landfill covering Infiltration of surface water would be reduced through the installation of a soil cover with a consistent grade

Alternatives 2 would have low to moderate short-term effectiveness This alternative has a chance of impacting workers, the public, and the environment during implementation Most of the potential health impacts would be due to potential inhalation of fugitive dust and the ingestion of dust and contaminated materials (hand to mouth) However, health and safety controls could be readily implemented to protect workers and the public A site specific HASP would be developed for the site that addresses worker safety including dust monitoring, decontamination procedures, etc Also, engineering controls, such as the addition of water to disturbed areas, would be implemented to control dust During the implementation of these alternatives, there would also be the potential for short-term impacts to the environment due to spills, dust, and surface run-off from disturbed areas These impacts would be readily controlled through appropriate transportation and engineering practices such as covering loads, cleaning up spills on-site, dust control measures, erosion protection, silt fences, etc In addition, construction activities would remove jurisdictional and candidate wetlands and a portion of the PMJM protection area within the boundary of the Original Landfill Formal consultation with USFWS would be required for potential PMJM impacts Wetlands mitigation and PMJM habitat mitigation would be required

Achieve Remedial Objectives

Alternative 2 would meet all of the remedial action objectives Radioactive contamination exceeding WRW and Ecological Receptor Action Levels would be removed from the surface soil of the Original Landfill The Landfill would be covered with an appropriately designed soil cover to prevent contact with the waste materials Construction activities would remove wetlands and a portion of the PMJM protection area within the boundary of the Original Landfill, however, the PMJM habitat would return after construction of the action

Implementability

Implementability addresses the technical and administrative feasibility of implementing an alternative of the required equipment, services and materials

Technical Feasibility

Alternatives 2 is technically feasible using proven controls and engineering design features that have been successfully implemented at other sites with similar conditions The removal of radiological contamination from the surface soil would use procedures that have been implemented at other RFETS locations All controls within the alternatives could be executed using readily available machinery including earthmoving equipment, haul trucks, and other conventional construction equipment

Alternatives 2 would require maintenance of the cover by routine inspections and repair as needed The monitoring of groundwater and surface water would be required, however the requirements may be slightly less than for Alternative 1 because a protective soil cover of a consistent grade would be built

Availability

For Alternative 2 mainly natural materials are required The cover materials would either come from an on-site borrow source, or a borrow source close to the site Monitoring would use industry standard equipment and materials that are also readily available

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Administrative Feasibility

The implementation of Alternative 2 does not require permits or easements, and does not impact adjoining property It will not inhibit the ability to impose institutional controls Existing site management and access controls would be maintained until a comprehensive final plan is implemented in the future The alternative is consistent with the aesthetic qualities of the facility end use as a wildlife refuge

Alternative 2 would remove jurisdictional wetlands and a portion of the PMJM protection area Therefore, formal consultation with USFWS would be required for potential PMJM impacts Wetlands mitigation and PMJM habitat mitigation may be required

Alternative 2 would most likely gain CDPHE, EPA, and community acceptance This alternatives offer a solution to protect public health and the environment with minimal technical feasibility issues

<u>**Cost**</u>

Evaluation of costs should consider the capital costs to engineer, procure and construct the required equipment and facilities, and the operating and maintenance costs associated with the alternative

Capital Cost

The capital cost to implement Alternative 2 is between \$5,000,000 and \$6,000,000

Operation & Maintenance Cost

The operation and maintenance costs associated with this alternative involve the inspection and maintenance of the cover Other monitoring costs, such as groundwater and surface water would also be included Operation and maintenance costs are estimated to be \$25,000 per year

Summary – Alternative 2

Alternative 2 implements the presumptive remedy, meets all of the remedial action objectives and attains the ARARs

6.2.3 Alternative 3 – Removal with Offsite Disposal

Alternative 3, Removal with offsite disposal is presented in 6 1 3 and generally includes the removal of radiologically contaminated surface soils, the removal and disposal of all OLF wastes and contaminated soils, and grading of the area to a stable configuration

<u>**Effectiveness**</u>

Effectiveness considers whether the alternative provides protection of human health and the environment, and achieves the remedial objectives

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Protectiveness

Alternative 3 would provide the highest level of long-term effectiveness, since all waste materials would be removed permanently from the OLF area Alternative 3 would rely upon proven techniques for waste excavation, classification, and disposal

Under Alternative 3 contamination removed from the OLF may require treatment, and after characterization would be disposed in an appropriately licensed facility However, prior to disposal, the waste may need to be treated to meet Land Disposal Restrictions (LDR)standards or other standards required by the disposal facility The types of treatment required would be identified during design and implementation Alternative 3 would comply with ARARs, although compliance with waste management requirements for treatment and disposal may prove difficult or impractical for some wastes This could lead to the need for waste storage at RFETS pending final waste disposition

Alternative 3 would have a moderate to high short-term effectiveness due to the exposure of waste to the workers during implementation and the potential for an offsite release due to transportation accidents This alternative would also remove jurisdictional and candidate wetlands within the boundary of the Original Landfill Wetlands and PMJM habitat mitigation may be required

Achieve Remedial Objectives

Alternative 3 would meet all of the remedial action objectives since all the waste materials would be removed from the site for disposal in off-site licensed facilities Construction activities would remove jurisdictional wetlands and a portion of the PMJM protection area within the boundary of the Original Landfill Formal consultation with USFWS would be required Wetlands mitigation and PMJM habitat mitigation may be required

Implementability

Implementability addresses the technical and administrative feasibility of implementing an alternative of the required equipment, services and materials

Technical Feasibility

Alternative 3 is technically feasible using only proven controls that have been successfully implemented at other sites with similar conditions The removal of radiological contamination from the surface soil would use procedures that have been implemented at other RFETS locations All controls within the alternatives could be executed using readily available machinery including earthmoving equipment, haul trucks, and other conventional construction equipment However, the handling, segregation, sampling, treatment and disposal processes for this alternative is technically challenging and will require additional operational and safety procedures for successful implementation

Off-site disposal included in the alternative would be technically feasible, as disposal facilities have been identified by RFETS and have been used for waste disposal in the past. However, this Alternative may require waste storage pending disposition of some wastes at disposal facilities

Alternative 3 would be the only alternative that does not require post action maintenance or monitoring by RFETS or the USFWS The commercial disposal facility would be responsible for all monitoring and maintenance

Availability

Required goods and services for implementation of the alternatives are reasonably available, although treatment may be costly and impractical for some wastes It is anticipated that the contractors, labor, equipment, and most of the materials will come from the Denver/Front Range area, which surrounds the site

Off-site disposal facilities are established for hazardous and radioactive waste generated at RFETS Solid waste would be disposed in a nearby State-permitted solid waste facility Off-site RCRA hazardous waste and low-level hazardous waste would be disposed at appropriate facilities (e g , NTS and/or Envirocare of Utah)

Administrative Feasibility

The implementation of Alternative 3 does not require permits or easements, and does not impact adjoining property It will not inhibit the ability to impose institutional controls Existing site management and access controls would be maintained until a comprehensive final plan is implemented in the future The alternative is generally consistent with the aesthetic qualities of the facility end use as a wildlife refuge

This alternative would remove jurisdictional wetlands and a portion of the PMJM protection area Therefore, formal consultation with USFWS would be required for potential PMJM impacts Wetlands mitigation and PMJM habitat mitigation may be required

Alternative 3 is administratively feasible, but is the most complex alternative since all waste will be removed from the OLF area and disposed off site Typical safety concerns with the transportation of radioactive and non-radioactive contamination from the site would be expected However, transportation of similar waste from RFETS is routine and is unlikely to cause public concern Appropriate safety measures would be implemented to protect the public during waste transportation.

Cost

Evaluation of costs should consider the capital costs to engineer, procure and construct the required equipment and facilities, and the operating and maintenance costs associated with the alternative

Capital Cost

The capital cost to implement Alternative 2 is between $200,000,000 and $400,000,000 depending of the actual composition of the waste materials and the need for treatment prior to disposal

Operation & Maintenance Cost

No operation and maintenance costs would be incurred with this alternative

Summary – Alternative 3

Alternative 3 is not retained for further consideration because the high costs of removal, treatment and disposal make this alternative impractical Alternative 2 will meet the remedial action objectives at a lower cost

6.2.4 Summary

This section discusses the results of the comparative evaluation for each remedial alternative for the OLF at RFETS The results are also summarized in Table 6-1 A proposed presumptive remedy alternative is recommended based upon this comparative evaluation

Alternative 1 would not be adequately protective of public health and the environment in the long term However, it could be easily implemented and is cost effective, but relies wholly on active controls to limit risks This alternative is not selected as the proposed accelerated action for the OLF

Alternative 2 would be effective in adequately protecting public health and the environment with the short disruption of the PMJM habitat The alternative is implementable This alternative includes post-accelerated institutional controls to maintain remedy effectiveness, but the controls are not difficult to implement The primary drawback to Alternative 2 is that it exposes some waste during the slope stabilization process, and creates potential worker safety and environmental issues This alternative is selected as the proposed accelerated action for the OLF because it is the most cost-effective and it implements the presumptive remedy

Alternative 3 provides the highest level of protection for public health and the environment with a short disruption of the PMJM habitat However, it presents the hgihest risk to workers implementing the action It is also extremely expensive due to the high cost of off-site disposal in licensed facilities Because of the high cost and long construction duration, this alternative is not selected as the proposed accelerated action for the OLF

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Table 6-1
Summary of Comparative Evaluation of Potential Remedial Alternatives

Criteria	Alternative 1 No Action	Alternative 2 Limited Grading & Soil Cover	Alternative 3 Removal with Off-Site Disposal
Effectiveness	**Low**	**Moderate**	**High**
Protection of Public Health and Environment	No reduction in potential exposure of refuge workers and wildlife to contaminated materials due to exposed wastes	Significant reduction in potential exposure of refuge workers and wildlife to contaminated materials with consistent cover	All waste removed from area
Long Term Effectiveness and Permanence	No long-term protection provided due to exposed waste	Proven technologies over the long term implemented	Removes all waste from the area
Short Term Effectiveness	Low due to exposed waste however PMJM and wetlands would not be affected	Moderate to High short-term effectiveness since risks associated with some limited movement of waste materials PMJM and wetlands mitigation required	Low short-term effectiveness due to the potential to release contamination from the excavation and movement of waste materials PMJM and wetlands mitigation required
Compliance with Remedial Action Objectives	Would not comply with chemical specific and location specific ARARs	Would comply with chemical location, and action specific ARARs	Would comply with chemical location and action specific ARARs
Implementability	**High**	**Moderate/High**	**Moderate**
Technical Feasibility	Technically feasible	Technically feasible	Technically feasible
Maintenance and Monitoring Requirements	Annual inspection maintenance and repair on as needed basis	Periodic inspection maintenance and repair on as needed basis	No maintenance or monitoring required
Construction Feasibility	Construction is feasible	Construction is feasible	Construction is feasible
Availability of Services and Materials	Not Applicable	All materials locally available	Disposal facilities available in U S
Administrative Feasibility	Not administratively feasible	Administratively feasible	Administratively feasible
Capital Cost*	**$100, 000 to $250,000**	**$5 MM to $6 MM**	**$200 MM to 400 MM**
O&M Cost ($/yr)	**$15,000**	**$25,000**	**$0**
Present Worth Cost**	**$550,000 to 700,000**	**$5 75 MM to 6.75 MM**	**$200 MM to 400 MM**
Regulatory/ Community Acceptance	**Low**	**Moderate**	**Moderate**

* Costs are in 2003 dollars

** Assumes 30 years of O&M without an escalation factor

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7.0 PROPOSED REMEDIAL ACTION PLAN

The remedial action plan for the OLF will consist of the following major activities to meet the RAOs

- Removal of surface soil "hot spots"
- Geotechnical investigation during the design
- Limited grading of landfill to slope of 18%
- Placement of a 2-foot soil cover over the entire fill area
- Geotechnical monitoring and data collection
- Engineering controls
- Site monitoring (Groundwater & Surface Water)
- Institutional controls

The objectives of this action are principally met through the removal of surface soils that are contaminated above the soil action level and the installation of the landfill soil cover However, additional continuing actions are required to maintain and assess the protectiveness and the effectiveness of the cover Further discussion of the actions in relation to attaining to the extent practicable Applicable or Relevant and Appropriate Requirements is contained in Section 8 0 Further discussion of Long-Term Stewardship activities is contained in Section 10 0 The continuing actions briefly described in this section are also summarized in Table 10-1

These actions will be taken until final remedy requirements are selected and incorporated (along with post-closure requirements for remedial actions taken at other IHSSs at Rocky Flats) in post-closure regulatory documents, which may include the final CAD/ROD for Rocky Flats or a post-closure RFCA-type agreement

7.1 Removal of Surface Soil Hot Spots

Surface soil with concentrations above the WRW and Ecological Receptor action levels would be removed as shown on Figure 4-2 It is estimated that the volume of soil meeting this criterion is less than 400 cubic yards

Surface soil exceeding the soil action levels will be stripped to a depth of 6-inches using standard soil excavation equipment The equipment would be used to move the contaminated surface soil to waste containers near the excavation The soil would then be managed in accordance with RFETS procedures and transported to an appropriately licensed, permitted facility for final disposal

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Control measures would be implemented during this activity to control the spread and release of contamination The control measures would include the establishment of work zones, decontamination procedures, dust suppression methods, traction mats, visual inspections, and radiological surveys Work would be suspended when environmental conditions such as during high winds that greatly increase the possibility of the spread of contaminated materials Monitoring would be performed, as necessary, to verify that there has been no release of contaminated materials

Areas excavated to remove radioactive hot spots will be carefully inspected with radiological field screening devices to determine the outer limits of the contaminated surface soil areas Field screening using standard RFETS instrumentation would be used to verification the depth and extent of excavation to below the action levels (e g , NE Electra, micro-R, Ludlum 12, HPGE) Confirmation soil samples would be taken for final isotopic and chemical analysis, as appropriate Following the confirmation samples, non-impacted soils from locations adjacent to the excavated areas would be moved to reduce surface slopes and to blend excavated areas into the surrounding surfaces prior to the action for the entire Original Landfill

7.2 Area Grading & Soil Cover

The waste fill area will be graded to a constant 18 percent (5 5 1) slope angle using a cut and fill approach that is as balanced as possible Standard earth-moving equipment, such as dozers, hoes or scrapers, would be used to cut the areas where the slope exceeds the desired 18 percent and to fill the areas where the slope is less than the desired 18 percent slope It is estimated that approximately 70,000 cubic yards of waste fill material would be moved during the process

Control measures would be implemented during the grading process to control the spread and release of waste materials in the Original Landfill The control measures would include the establishment of work zones, decontamination procedures, dust suppression methods, traction mats, visual inspections, and radiological surveys Work would be suspended when environmental conditions could greatly increase the possibility of the spread of contaminated materials Monitoring would be performed, as necessary, to verify that there has been no release of contaminated materials

After the grading of the landfill surface is complete, a soil cover will be placed over the landfill to a minimum thickness of 2 feet About 65,000 cubic yards of local or onsite soil will be used to construct the cover The soil cover will be compacted sufficiently to provide a stable cover system to promote surface water runoff, reduce surface water ponding, and increase overall slope stability

Revegetation of the soil cover with native species will reduce infiltration and control erosion. This approach is in keeping with the current strategy to restore the RFETS with the native prairie grasslands as closely as possible The seeding will be conducted along with erosion control matting or mulch to prevent erosion of the cover while allowing the vegetation to establish a strong stand

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The following plant properties will ensure healthy, productive, and long-term vegetative growth on the landfill cover

- Locally-adapted, non-invasive or native species able to withstand Front Range drought and temperature extremes will be used as vegetative cover

- Long-term fertilization and nutrient supplements are not planned at this time, therefore, it is critical that the vegetation be able to survive under existing soil conditions Native grasses and forbs will thrive with little maintenance Soil amendments may be provided to supplement borrow material to establish initial vegetation on the cover

- Both cool and warm season species will be planted to provide transpiration throughout as much of the year as possible Locally-adapted species of grasses and forbs normally transpire all available water in semi-arid climates, such as that at RFETS

- A strong stand of vegetation will limit cover erosion from both wind and water

A draft seed mix will be developed during the design in consultation with U S Fish and Wildlife Service (USFWS) and the RFETS Ecology Group

7.3 Geotechnical Investigation During Design

As presented in Section 2 6, the stability of the slopes at the present landfill is uncertain, however, there are currently no indications of subsurface movement of the landfill since there is no evidence of surface separations To further define the level of landfill stability, the design of the remedial action will include an accurate topographic survey and a geotechnical investigation The geotechnical investigation will use the past geotechnical assessments as a resource to determine the scope of this additional investigation The purpose of the geotechnical investigation will be as follows

- Assess the stability of the underlying soil and bedrock with the configuration of the limited grading and cover alternative,

- Assess the impact of groundwater on the underlying soil and bedrock stability with the configuration of the limited and grading cover alternative, and

- To collect the needed geotechnical information to design a long term, landfill stability monitoring plan

This geotechnical investigation will also determine if a retaining wall is needed at the toe of the landfill slope and/or a groundwater barrier is needed upgradient of the landfill to promote structural stability The results of the geotechnical investigation will be available to the CDPHE, EPA and stakeholders for the transfer to landfill technical information.

7.4 Geotechnical Monitoring & Data Collection

Slope and fill stability monitoring will be planned as a part of the remedial action to accompany the installation of the soil cover This data will be important in accessing the behavior of the fill material and subsoils during the monitoring period A detailed monitoring plan will be prepared as a part of the remedial design along with the gathering of additional data as described in Section 7 3

7.5 Engineering Controls

Engineering controls may be used to provide a physical barrier to protect the public and wildlife refuge workers from potential risks at the site The engineering controls may include fencing and signage to limit public access A chain-link fence could be constructed around the perimeter of the OLF area, which is approximately 4,000-ft long Signs would be posted on the fence at 200-foot intervals

7.6 Site Monitoring

Site monitoring will include a program to ensure that current conditions at the site do not change in an adverse manner Surface water and groundwater monitoring will be instituted to identify impacts after the action has been implemented An annual walkdown of the area will be conducted to identify areas of erosion of the soil cover for repair A ground survey will also be completed to monitor slope stability More details regarding site monitoring is presented in Section 10 0 Monitoring locations will be determined during the design of the accelerated action

7.7 Institutional Controls

General and specific post-accelerated action institutional controls for RFETS as a whole are currently being evaluated by DOE and the regulatory agencies, and in consultation with the USFWS, and the community

The controls that will be implemented at the OLF for this proposed action are as follows

1 Current Site-wide security and access controls will be maintained until completion of the RFETS Closure Project, currently scheduled for December 2006, but will be replaced by equivalent controls for the OLF and other specific areas for which security and access controls are required

2 In accordance with the Rocky Flats Wildlife Refuge Act of 2001 (Pub L 107-107, Sec 3171-3182, [December 28, 2001]), DOE will retain jurisdiction over the engineered controls associated with the proposed action

3 Prohibition of drilling and pumping of groundwater wells for uses other than the remedy

4 Prohibition of the use and excavation of the cover and of the area in the immediate vicinity of the cover

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5 Prohibition of drilling on and in the immediate vicinity of the cover

6 Prohibition of disruption of surface water sampling stations until such stations are no longer needed

7 To avoid adverse impacts, roads and trails will not be allowed on the cover or the immediate vicinity of the cover Signs may be erected that indicate vehicles are prohibited from specific areas and that direct vehicle traffic appropriately A determination will be made during project construction as to whether signs or fences will be used as the preferred means of restricting access

8 Upon construction completion, fencing around the cover, or specific locations on or around the cover, will also be considered to limit the potential for damage or tampering with the location Signs and markers may be used as controls to delineate the landfill boundary, outline digging, fishing, swimming, groundwater, and surface use restrictions, and/or describe access restrictions to the landfill cover and monitoring locations for the cover

Final institutional and physical controls for the accelerated action will also be documented in the closeout report Inspection of these institutional controls will be performed quarterly to determine their continuing effectiveness Results of these inspections will be reported annually

7.8 Worker Health and Safety

All work under this proposed action will be controlled using the Site Integrated Safety Management System (ISMS) and the Integrated Work Control Program (IWCP) A project specific Health and Safety Plan (HASP) will be developed to address the safety and health hazards of project execution and specify the requirements and procedures for employee protection The Occupational Safety and Health Administration (OSHA) construction standard for Hazardous Waste Operations and Emergency Response, 29 Code of Federal Regulations (CFR) 1926 65 will be used as the basis for the HASP In addition, DOE Order 5480 9A, Construction Project Safety and Health Management applies to this project This Order requires preparation of an Activity Hazard Analyses (AHA) for each task, which includes identifying each task, the hazards associated with each task, and the controls necessary to eliminate or mitigate the hazards The AHAs will be included in the HASP

Data and controls will be continually evaluated. If field conditions were to vary from the planned approach (for example, when unanticipated hazards are encountered, such as contaminated debris and airborne contamination), an AHA would be prepared for the new conditions, and work would proceed according to the appropriate control measures

8.0 APPLICABLE OR RELEVANT & APPROPRIATE REQUIREMENTS

As required by Part 4 of RFCA, the proposed action will be performed to the extent practical in compliance with applicable or relevant and appropriate requirements

(ARARs) under CERCLA ARARs have been identified for the proposed action consistent with the National Contingency Plan, the preambles to the proposed and final National Contingency Plan, and CERCLA Compliance with Other Laws Manuals Part I and Part II (EPA 1988 and 1989)

As required by Part 4 of RFCA, the proposed action will be performed to the extent practical in compliance with applicable or relevant and appropriate requirements (ARARs) under CERCLA ARARs have been identified for the proposed action consistent with the National Contingency Plan, the preambles to the proposed and final National Contingency Plan, and CERCLA Compliance with Other Laws Manuals Part I and Part II (EPA 1988 and 1989)

The ARARs are provided in Appendix A This section provides additional detail for the ARARs related to closure of the Original Landfill under the regulations pertaining to any environmental permits that would potentially be required, but to which the CERCLA permit waiver applies

Requirements with long-term stewardship implications are summarized in Table 10-1

8.1 Storm Water

Given the expected conditions at the OLF site, no significant surface water impacts are anticipated as a result of storm water events However, because the total area of the project is greater than five acres and the location is outside the Industrial Area, which has an effective NPDES Permit for Storm Water, the proposed action would require an NPDES Storm Water Permit for Construction Activities, but for the fact that it is a CERCLA action Paragraphs 16 and 17 of RFCA establish the requirements under which CERCLA permit waiver applies For any action that would require a permit but for CERCLA, Paragraph 17 requires that the following information be included in the submittal

a Identification of each permit that would be required – Because the landfill cover construction project is greater than five acres in size, an NPDES General Storm Water Permit for Construction Activities would be required The permit is found at 40 CFR Part 122, and is obtained by filing a Notification of Intent (NOI) with EPA [1]

b Identification of the standards, requirements, criteria, or limitation that would have had to have been met to obtain each permit – Because the storm water permit for construction activities is a general permit, it has been through public comment and promulgated by EPA Obtaining the permit is through the NOI (i e , a letter submittal to the agency containing basic information about the project) The permit requires the installation of best management practices, such as silt fences, to protect downstream waters from sediment-laden run-off These requirements will be a part of the cover design

[1] This IM/IRA serves as the NOI for the Original Landfill project

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c Explanation of how the proposed action will meet the standards, requirements, criteria, or limitations identified in subparagraph (b) – The total area of disturbed soils is approximately 22 acres, including the area of the landfill to be resurfaced (20 acres) and miscellaneous construction activities (2 acres) Surface water control measures will be used to minimize surface water contact with potentially contaminated soils or groundwater and to minimize erosional effects during the construction activities Precipitation falling on areas where construction is in progress will be diverted to existing surface water drainage ditches Other shallow ditches will be temporarily constructed as needed to prevent sediment-laden storm water from flowing directly into Woman Creek

Newly-constructed soil surfaces will be protected using soil terracing, hydromulch, straw-mulch, silt fencing or other appropriate method to minimize soil erosion and surface water degradation until the required vegetation is established The use of straw-mulch, adequately spaced silt fences, and other appropriate measures minimize soil loss and allow the final vegetative cover to be established

8.2 Migratory Bird Treaty Act

Construction activities may impact migratory birds protected by the Migratory Bird Treaty Act, and the Fish and Wildlife Conservation Act Due to the variations in potential impacts and depending upon the season and nesting schedules for migratory birds, the substantive requirements of these federal statutes will be evaluated by the Site Ecology group prior to conducting activities associated with the proposed action The substantive requirements identified during the evaluation will be implemented throughout the construction process

9.0 ENVIRONMENTAL IMPACTS

Paragraph 95 of RFCA mandates incorporation of National Environmental Policy Act (NEPA) values into RFETS decision documents This section of the IM/IRA satisfies the RFCA requirement for a "NEPA equivalency" assessment of environmental consequences by addressing the environmental consequences of the remedial action

The remediation impact analysis relies heavily on conclusions reached in the Cumulative Impact Document (CID, DOE 1997) and the 2000 CID Update Report (DOE 2001), both of which focus on cumulative impacts resulting from onsite closure activities In general, the proposed action will have very little adverse short-term impacts in a variety of resource areas, including air quality, water quality, traffic congestion, and ecological resources In some instances, the impacts could be intense for a short period of time However, the impacts will not notably affect human health and safety, or the environment, and they will be temporary and controlled through mitigation actions (e g , dust will be controlled with water sprays during placement of the cover)

The proposed action will have both positive and adverse effects Positive impacts, such as increasing wildlife habitat through revegetation of the landfill area and limiting movement of potential landfill contaminants, are identified in this section Adverse impacts identified in this section can often be mitigated through avoidance, minimization, remediation, reduction, or compensation Certain mitigation measures are required by law For example, wetland losses will have to be replaced or repaired This section presents identified mitigation measures by each resource area

Notable potential environmental impacts associated with remediation of the OLF include ecological resources (e g , PMJM), surface water, and groundwater Other issues discussed under this NEPA-equivalent section include air quality, soils and geology, human health and safety, transportation, and this project's contribution to site-wide cumulative impacts

The OLF project does not affect compliance with the Historic Preservation Act of 1966 Since the project area has been disturbed previously, and the most of the subsurface will not be further disturbed, the discovery of archeological or historic artifacts is very unlikely If such artifacts are encountered, work will be stopped and appropriate RFETS procedures will be followed

Equipment used and dust generated during the construction activities will be visible evidence of the action Dust clouds could generate concern among the general public, but will dissipate before the leaving RFETS as a visible cloud or plume Dust control measures, such as watering, will also suppress visible dust clouds These visible effects will be temporary Long-term, the reclamation of the area will provide a more natural appearing landscape that would be considered an improvement by most observers

Noise levels will be temporarily elevated during construction activities, but are not expected to exceed levels commonly encountered during highway construction projects Sensitive human receptors are not found near the construction area, and the noise should not be noticed off site Noise may be significant to certain wildlife species (especially the PMJM) at certain times of the year, and will be addressed as discussed in Section 8 4

In accordance with Executive Order 12898, the potential impact of the proposed action on minority and low-income populations is considered The proposed action will occur onsite away from inhabited areas, and will not lead to off-site indirect effects on nearby populations Disproportionately high and adverse human health or environmental effects will not be imposed on these populations The proposed action will provide short-term employment for a limited number of people, and socioeconomic effects of the action will be minimal

9.1 Impacts to Air Quality

The purpose of this section is to assess the potential impacts to air quality associated with the proposed installation and maintenance of the soil cover, including fugitive dust emissions and methane emissions

9.1.1 Potential Fugitive Dust Emissions

The primary pollutant generated as a result of the proposed action will be fugitive dust, which includes total suspended particulates (TSP) and particulate matter 10 micron (PM_{10}), and particulate matter 2 5 microns ($PM_{2\,5}$) in size Dust emissions from cover construction activities will be controlled with practical, economically reasonable, and technologically feasible work practices, as required by the CAQCC Regulation No 1 Specifically, onsite dust will be controlled through dust minimization techniques, such as the use of water sprays to minimize suspension of particulates, and terminating earthmoving operations during periods of high wind In addition, PM10 will be monitored consistent with the Site IMP (RFETS 2000) Particulate emissions will be short-term and controllable, and emissions are not expected to be above enforceable National Ambient Air Quality Standards at the RFETS perimeter Therefore, potential impacts to workers and the public from proposed action will not be significant

9.1.2 Potential Equipment Emissions

Cover construction activities will also include operation of vehicles, heavy machinery, and other equipment that generate other criteria pollutants Estimated concentrations of other criteria and Hazardous Air Pollutants provided in the CID (DOE 1997) were well below the most restrictive occupational exposure limit, with the exceptions of sulfur dioxide, nitrogen dioxide, and carbon monoxide, which approached 50 percent of the most restrictive occupational exposure limit The CID (DOE 1997) identified the primary sources of these pollutants as diesel-powered emergency generators used to supply backup power at RFETS According to the 2000 CID Update Report (DOE 2001), maximum daily emissions will remain about the same as forecast in the CID (DOE 1997) Equipment emissions from cover construction activities are expected to be substantially less than the CID (DOE 1997) and 2000 CID Update Report (DOE 2001) estimates, therefore, impacts to workers and the public are not a concern

9.2 Impacts to Surface Water

Construction activities associated with installation of the cover will result in surface disturbance from the clearing of vegetation, excavation and salvage of topsoil material, blading and leveling of land preceding construction, and the potential for accidental uncovering of contaminated media Potential impacts to surface water during the construction phase include increased erosion, and subsequent sediment loading to drainage ditches and Woman Creek during storm events The absence of vegetative cover results in increased potential for both sheet and channelized run-off, and wind and water erosion, resulting in increased sedimentation of ditches and Woman Creek

Cover construction may require some soil obtained from offsite commercial operations or on-site sources Excavation of these borrow materials has impacts similar to those identified above Off-site facilities address these issues through permits issued to the facility

The remedial construction activities are expected to have limited physical contact with contaminated soils or waste materials In the event equipment and personnel come in

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contact with potentially contaminated materials during construction, decontamination will be performed at the RFETS main decontamination facility to reduce potential impacts to surface water

Long-term impacts will be minimized because the cover along with the current groundwater management systems will minimize infiltration of precipitation and subsequent contact with contaminants, and it will incorporate surface drainage features to prevent run-on/run-off and to provide erosion control The proposed action will result in a decrease in the risk of contaminants reaching surface water by reducing the precipitation contacting contaminated soils or waste materials Precipitation falling within the boundary of the landfill will be drained from the cover and diverted away from the landfill Surface water drainage from areas outside the landfill boundary would be prevented from flowing onto the landfill and diverted around the boundary Using appropriate surface-reclamation measures, adequate vegetative cover will be established on the final surface of the landfill The establishment of vegetative cover on stabilized slopes, contours of the landfill, and the surrounding disturbed surfaces will greatly reduce erosional hazards to levels similar to surrounding areas

Post-closure monitoring activities will include inspections of the landfill surface and associated drainage ditch conditions Observations of the vegetative cover and evidence of soil erosion and loss will be included in the routine inspection and maintenance activities Further erosion control measures, regrading, and revegetation will be implemented if maintenance inspections indicate the landfill surface reclamation is not effective as planned

Presently, the Woman Creek drainage basin has an artificial water control structure, the SID, which intercepts runoff above the OLF and routes it to Pond C-2 This runoff does not flow across the landfill area, water flows across the OLF only during precipitation or snowmelt events that are sufficient to allow water to reach the creek before being absorbed or evaporated Such events are infrequent

The SID in the area of the OLF may be eliminated as result of the proposed action The SID could be effectively replaced with installation of the cover Removal of the SID could enhance the overall stability of the landfill

9.3 Impacts to Groundwater

Groundwater quality in the area of the OLF is not significantly impacted The intended purpose of the cover is to prevent water from contact with potentially contaminated landfill material, and thereby provide a long-term benefit to the environment The cover will also reduce surface water from percolating through the landfill to the groundwater These measures will prevent localized contamination of groundwater The soil cover will provide an overall positive impact to groundwater and should enhance groundwater quality at the site No significant negative impact to groundwater quality is expected from the remedial action

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9.4 Impacts to Wildlife & Vegetation

The OLF project activities will have varying impacts on ecological resources within the project area. Impacts to ecological resources are unavoidable, but adverse impacts will be minimized through mitigative measures The Proposed Action will principally affect wetlands, migratory bird habitat, and habitat for the PMJM (*Zapus hudsonius preble*), a federally-listed threatened species under the Endangered Species Act Impacts to the PMJM and wetlands may require mitigation (i e , a replacement of habitat of equal value either on-site or off-site) Habitat for native animals will change slightly, as the hillside is revegetated during remediation of the Original Landfill The changes will improve the quality of the vegetation by replacing exotic species with native species The changes will adversely affect some species, but will likely have a long-term benefit for most endemic species

Because the PMJM is a federally-listed threatened species, its habitat is a primary concern at RFETS Several acres of PMJM habitat is located on RFETS The PMJM is found in the riparian woodland/shrubland habitat along Woman Creek, and designated PMJM habitat extends into the southern portion of the OLF area as shown in Figure 3-4 Some designated PMJM habitat will be lost permanently within the project area because of soil cover (landfill cap) constraints However, some area of PMJM habitat will be temporarily impacted by the project Both temporary and permanent impacts will be mitigated through consultation with the U S Fish and Wildlife Service (USFWS)

Other animal species will lose existing habitat when the OLF area is remediated The soil cover may limit the types of animals that eventually occupy the area The changes, however, will benefit yet other species Many endemic species are adapted to prairie environments and would readily inhabit the reclaimed Original Landfill

Migratory birds are protected under the Migratory Bird Treaty Act Both the birds and their nests are protected under this law Currently, a great horned owl has been nesting in one of the large cottonwood trees in the OLF area Other songbirds occasionally nest in the trees and shrubs or on the ground in the OLF area Active nests will be protected, inactive nests will be removed prior to construction activities, through the use of special permits from the USFWS While long-term habitat changes that result from the proposed action will adversely affect some bird species (e g , loss of a nesting site for the owl), other species (e g , grassland species) will benefit from the changes

Much of the OLF project area is currently dominated by noxious weed species, such as diffuse knapweed and scotch thistle These weeds have invaded the disturbed ground within the project area over the past decade Additionally, non-native species of grasses, such as smooth brome and intermediate wheatgrass, were planted along the SID after it was constructed These non-native species will be replaced with native species that provide better wildlife forage and habitat, and increase the natural resource values of the area

There are several small wetland areas within the boundary of the OLF project area that will be destroyed The impacted areas are subdivided as follows

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- SID Wetlands The entire SID wetland area is 3 06 acres, the portion of the SID that will be affected by the proposed action is 0 34 acres

- Woman Creek Wetlands About 1 70 acres will be impacted This area is overlain by the PMJM protection area

- Candidate Wetlands Eight small isolated areas identified as potential wetlands, totaling about 0 91 acres, are located north of the SID Designation of these areas as "jurisdictional" is currently in discussion

A conceptual approach to mitigating wetland damage at the OLF is being developed The approach to offset wetland losses is based on a worst-case scenario, wherein all wetlands on the hillsides and along Woman Creek are impacted A Wetlands Mitigation Plan will be prepared that describes the actions that will be taken to replace wetlands that are destroyed Both *in-situ* wetland creation/restoration and the use of wetland bank credits have been proposed for mitigation of wetland impacts The use of either technique or a combination of the techniques is subject to review and approval by the USFWS The mitigative measures are therefore considered sufficient to offset losses and other adverse impacts to wetlands

The OLF project may temporarily affect water quality from eroded soils during construction Erosion controls will be used to minimize water quality effects Long-term, water quality may improve slightly, while surface water flow volumes may change due to the design of the new landfill cover Such changes would be minimal and would occur sporadically (e g , after heavy rains) The minor potential changes in surface water flow volumes will not change or affect lower Platte River species that depend on instream flows

Soil materials may be obtained from offsite commercial operations for fill and capping operations, and the excavation of borrow materials will impact wildlife and vegetation at those locations Commercial facilities must comply with the Endangered Species Act, and threatened and endangered species are therefore protected The impact to other species will vary but will depend on the facility and extent of the operations However, these indirect impacts are considered in operational permits issued for the facilities by state and local county governments

9.5 Impacts to Transportation

The proposed action will only slightly impact both onsite and offsite transportation systems Increased onsite truck traffic will be an inconvenience, but safety risks will be low, and impacts will be mitigated by very low and closely observed speed limits In comparison analyses in the CID (DOE 1997, DOE 2000), offsite traffic impacts will not increase substantially

9.6 Impacts to Cultural & Historic Resources

The RFETS was placed on the National Register of Historic Places as a Historic District (5JF1227) on May 19, 1997 Historic District designation mandates compliance with the

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Historic Preservation Act of 1966, and the Programmatic Agreement among DOE, the Colorado State Historic Preservation Officer, and the Advisory Council on Historic Preservation Regarding Historic Properties at RFETS. While the remedial action will be conducted within the Historic District boundaries, no impact is expected to occur to protected structures

9.7 Impacts to Visual Resources

During installation of the cover, bulldozers and other equipment may be visible from offsite locations Dust generated during earthmoving operations may be temporarily visible, but will dissipate before leaving the Site as a visible cloud or plume of dust Control measures, such as watering, will be used if needed to control dust

9.8 Noise Impacts

Noise levels may be elevated during construction of the cover Noise levels will not exceed those commonly encountered at a highway construction site Appropriate hearing protection will be supplied to project personnel as identified in the project-specific health and safety plan

9.9 Cumulative Impacts

The proposed action supports the overall mission to clean up RFETS and make it safe for future uses The cumulative effects of this broad, sitewide effort are presented in the CID (DOE 1997) and 2000 CID Update Report (DOE 2001), which describe the short-term and long-term effects from the overall cleanup mission

The primary focus of the CID (DOE 1997) was on cumulative impacts resulting from onsite activities conducted during Site closure Cumulative impacts result from the effects of Site closure activities and other actions taken during the same time in the same geographic area, including offsite activities, regardless of what agency or person undertakes such other action The analysis contained in the 2000 CID Update Report (DOE 2001) included updated onsite and offsite transportation activities, as well as several new offsite activities, although the future non-DOE projects are relatively uncertain Increased traffic congestion will be the most noticeable impact according to the 2000 CID Update Report (DOE 2001), resulting from increased RFETS traffic and other planned or proposed construction projects near RFETS Air pollutants and noise will also have adverse impacts; however, the impacts are expected to be short-term in nature, with staggered project start and completion dates Most people will perceive a positive, long-term visual and "quality of life" benefit, as RFETS infrastructure and equipment are removed, returning RFETS to a more natural appearance

The cumulative impacts of the proposed action are expected to be similar to those analyzed in the CID (DOE 1997) and 2000 CID Update Report (DOE 2001) Over the short term, additional construction personnel will have an additive effect on the existing workload for Site operations, and there will be increased air emissions, visual impacts, noise, and traffic impacts resulting from construction activities These short-term impacts will be minimal Long-term impacts (i e , OLF cover construction activities in conjunction with other environmental restoration work and facility decommissioning activities) facilitate future use of the Site and fulfill the mandated cleanup objectives

9.10 Irreversible & Irretrievable Commitment of Resources

The proposed action will result in a variety of permanent commitments of resources but it is not expected to result in a substantial loss of valuable resources Most of the resources used for construction of the cover are permanently committed to implementation of the remedial action Irreversible and irretrievable resources are defined as resources that are either consumed, committed, or lost At the Original Landfill, irreversible and irretrievable resources include the following

- Consumptive use of geological resources (e g , quarried rock, clay, sand, and gravel for road construction) will be required for construction activities Supplies of these materials will be provided by an onsite, offsite, or offsite commercial borrow source The proposed action requires a permanent commitment of fill, topsoil, and vegetative cover to construct the OLF cover However, adequate supplies are available without affecting local demand for these products

- Fuel consumed by construction equipment and vehicles used for the construction of the OLF cover will not be recovered

- Soils in the vicinity of the OLF will be disturbed by construction activities Many impacts are temporary, pending completion of remedial activities and associated restoration programs

- The commitment of up to 30 acres of land as a landfill permanently commits and constrains the area to limited land-use options

- Wetlands and associated natural resources will be reduced at the Original Landfill Long-term direct impacts to the floodplain resulting in changes of flood elevations will not occur

- A long-term commitment of personnel and funds will be required to perform post-closure inspection, maintenance, and monitoring activities

- Commercial, industrial, and residential land uses are permanently prohibited within boundaries of the OLF due to construction of the cover and the network of monitoring wells

- Incidental resources that are consumed, committed, or lost on a temporary and/or partial basis during construction include construction personnel and equipment, the construction water source, and the some construction materials for staging and access

- Appropriate landfill surface reclamation will result in an acceptable appearance of the remediated site, and the ecological succession of the closed landfill and adjacent land are improved by surface revegetation Vegetation and habitat eventually become similar to surrounding areas

- Monitoring and maintenance activities will be performed, as necessary, to ensure long-term protection of human health and the environment

10.0 ADDITIONAL LONG-TERM STEWARDSHIP CONSIDERATIONS

The objective of this section is to identify additional post-closure care (that is, long-term stewardship) requirements of the proposed accelerated action for the Original Landfill These requirements are necessary for the long-term effectiveness of this remedy and include the following components information management, periodic review, and maintenance of a responsible controlling authority Other requirements necessary for the short- and long-term effectiveness of the remedy are identified in Sections 7 and 8, including institutional controls, inspection and maintenance, and environmental monitoring These requirements are specific to the accelerated actions described in this IM/IRA and are summarized in Table 10-1 Additionally, these requirements will ultimately be captured (along with post-closure care requirements from other accelerated actions at Rocky Flats) in post-closure regulatory documents, which may include the final CAD/ROD for Rocky Flats or a post-closure RFCA-type agreement

10.1 Information Management

A successful stewardship program is dependent on retaining the necessary records about the history and residual contamination of the site Retained information should include the history of the site, the COCs, the selected remedies, the use of controls and their associated monitoring and maintenance records, and any other information judged necessary for succeeding generations to understand the nature and extent of the residual contamination At a minimum, the following records will be retained, stored, and retrievable for this accelerated action

- This IM/IRA and any future modifications,
- The final design for the cover and field change requests,
- The as-built drawings of the cover,
- The monitoring and maintenance manual and subsequent revisions,
- Inspection records and logbooks,
- Maintenance records and logbooks,
- Annual performance assessment reports,
- CERCLA five-year review reports,

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- Correspondence between the agencies associated with modifications to the post-closure care regime,
- The Memorandum of Understanding (MOU) between DOE and the U S Department of Interior (DOI) (identifying the controlling authority,
- The CAD/ROD, and
- The RFETS Historical Release Report (HRR) and other relevant historical documentation

This information will be maintained in the Administrative Record (AR) File Currently, the AR File is maintained onsite DOE is currently looking at options for retention of permanent records following Site closure

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Table 10.1
Summary of OLF Post-Accelerated Action Monitoring, Maintenance, and Institutional Control Requirements

Area	Action	Frequency of Action	Criteria	Possible Follow-on Action
Cover	Visual Inspection	Quarterly for five years	Differential Settling/Subsidence	Repair, as necessary
			Erosion	Repair erosion areas with soil and rock, as necessary
			Unwanted Vegetation	Remove deep rooting trees or employ weed control measures, as necessary
			Burrowing animals	Remove and repair damage, as necessary
Perimeter Drainage Ditches	Visual Inspection	Quarterly for five years	Erosion	Repair erosion areas with soil, erosion blankets and reseeding, as necessary
			Unwanted Vegetation	Remove deep rooting trees or employ weed control measures, as necessary
Surface Water Sampling Stations	Sampling	Quarterly for five years	Analyze for VOCs and metals Effluent limitations are the surface water standards (RFCA Attachment 5, Table 1)	If a surface water standard is exceeded, sampling will increase to monthly for three consecutive months If exceedances continue, the RFCA Parties will consult to determine whether a change in the remedy is required, additional parameters need to be analyzed, or if a different sampling frequency is required
Groundwater	Sampling	Quarterly for five years	Increasing trend in VOCs and metals in downgradient versus upgradient RCRA groundwater monitoring wells	Statistically significant changes in downgradient versus upgradient groundwater quality will require consultation between the RFCA parties to determine if changes to the remedy are required
Institutional and Physical Controls	Visual Inspection	Quarterly for five years	Security and Access Controls, and overall site conditions	Check signs, fences (if required), markers, and overall condition of the present Landfill site to determine continuing effectiveness of institutional and physical controls

10.2 Periodic Assessments

Periodic assessments are performed to determine whether the selected remedies and stewardship controls continue to operate as designed, and ascertain whether new technologies might exist to eliminate remaining residual contamination in a safe and cost-effective manner The CERCLA five-year review process is required for all Superfund sites that leave residual contamination behind after closure, and will establish the minimum requirements for post-closure periodic assessments EPA Comprehensive Five-Year Review Guidance (2001) describes the format of the review and suggests mechanisms that can be implemented through the five-year review process to ensure the protectiveness of the remedy

DOE is responsible for conducting the five-year reviews EPA then issues a finding of concurrence or nonconcurrence The public has indicated an interest in performing reviews more frequently than the five-year interval specified in CERCLA DOE intends to work with its stakeholders to arrive at a review regimen that meets community needs

The periodic assessment will include actions such as evaluating monitoring and maintenance records, verifying regulatory compliance, and determining whether land use assumptions are still valid Specific topics for the periodic assessment for the OLF are likely to include cover performance, landfill stability, surface water quality and groundwater quality, and the need to continue monitoring

10.3 Controlling Authority

Long-term protection of human health and the environment necessitates that a controlling authority be established with responsibility for post-closure management CERCLA mandates that DOE, as a responsible party, will retain responsibility for the contamination at RFETS resulting from its activities there, as well as responsibility for long-term maintenance of any remedies The Rocky Flats National Wildlife Act of 2001 requires that, following certification by EPA, certain lands of the current Site will be transferred from the Secretary of Energy to the Secretary of the Interior These lands would be under administrative jurisdiction of the Service The Act also requires the Secretary of Energy to retain administrative jurisdiction over Site lands required to carry out response actions required for the cleanup and closure of the Site The MOU currently being negotiated between DOE and DOI will outline this process, although it is unlikely the final boundaries of the land to be transferred will be determined until the final cleanup and closure plans are approved However, the OLF will remain under the administrative jurisdiction of the Secretary of Energy

10.4 Reporting requirements

Sections 7, 8 and 10 include annual reporting requirements for data results, inspection results, repairs, and routine maintenance These requirements may be combined into one report and may be combined with future site-wide maintenance and monitoring reports

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11.0 IMPLEMENTATION SCHEDULE

It is anticipated that the remedial action will take about 9 months to complete and be implemented during Fiscal Year 2005

12.0 CLOSE-OUT REPORT

Upon completion of the remedial action at the Original Landfill, a Closeout Report will be prepared in accordance with RFCA The Closeout Report will document the work completed within the scope of this IM/IRA The expected outline/content for the Closeout Report is as follows

- Introduction,
- Remedial action description,
- Dates and duration of specific activities,
- Deviations from the decision document,
- Final disposition of any wastes generated,
- Demarcation of wastes left in place (i e , survey bench marks and measurements),
- Demarcation of areas requiring access controls,
- A copy of the Vegetation Plan, and
- A copy of the Monitoring and Maintenance Plan

Upon completion, the Closeout Report will be submitted for review and approval by CDPHE and EPA, and placed in the Administrative Record File

13.0 ADMINISTRATIVE RECORD

The Administrative Record (AR) File for the proposed accelerated action to be conducted pursuant to this IM/IRA is available in the Rocky Flats Reading Room, located at

Front Range Community College
3705 112th Avenue
Westminster, Colorado, 80030

(303) 469-4435

The AR File contains the documents listed in section 15 0, References

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Upon approval of the Final IM/IRA, the AR shall consist of the approval letter, the Final IM/IRA (which will include section 14 0, Comment Responsiveness Summary), the documents listed in section 15 0, References, and any additional documents identified for inclusion in the AR in the Final IM/IRA

An AR File for the implementation phase of the Final IM/IRA will be maintained as governed by Site AR policies and procedures, pursuant to the RFCA Community Relation Plan The Final Closeout Report for the project will be included in the AR File In addition, project-specific information, such as project correspondence, work control documents, and other information generated as a direct result of this project, will be filed in the Project Record The Project Record files will be transferred to Site Records Management upon completion of the Final Closeout Report

14.0 COMMENT RESPONSIVENESS SUMMARY

Responses to comments on this IM/IRA received during the formal public comment period, including comments from the regulatory agencies, will be documented in the Appendix C

15.0 REFERENCES

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Appendix A

ARAR's

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REQUIREMENT	CITATION	TYPE	COMMENT
ATOMIC ENERGY ACT (AEA) [42 USC 2200 et. seq.]			
CHRONIC BERYLLIUM DISEASE PREVENTION PROGRAM • Definitions • Release criteria • Waste disposal • Warning labels	10 CFR 850 3 31 32 38 (b-c)	A	Establishes a program to reduce the number of worker currently exposed to beryllium in the course of their work at DOE facilities The cited sections are followed in relation to determinations of beryllium contamination and release to the public

REQUIREMENT	CITATION	TYPE	COMMENT
CLEAN AIR ACT (CAA) [42 USC 7401 et. seq.]			
COLORADO AIR QUALITY CONTROL COMMISSION (CAQCC) REGULATIONSCOLORADO AIR POLLUTION REGULATIONS	5 CCR 1001 [40 CFR 52, Subpart G]		
• Emission Control Regulations for Particulates, Smokes, Carbon Monoxide, and Sulfur Oxides	CAQCC Reg No 1 [5 CCR 1001-3]		
- Smoke and Opacity	Section II A 1	C	Air pollutant emissions from stationary sources shall not exceed 20% opacity (emissions from pumps, generators, and compressors)
- Fugitive Particulate Emissions - Construction Activities - Storage and Handling of Material	Section III D III D 2(b) III D 2(c) III D 2(e)	A	Every activity shall employ control measures and operating procedures that are technologically feasible and economically reasonable which reduce, prevent, and control fugitive

A – Action-specific ARAR, C – Chemical Specific ARAR, L – Location-Specific ARAR, TBC – To Be Considered

REQUIREMENT	CITATION	TYPE	COMMENT
CLEAN AIR ACT (CAA) [42 USC 7401 et. seq.]			
- Haul Roads - Haul Trucks	III D 2(f)		particulate emissions (control plans, use of control equipment, watering, etc) These requirements apply to disturbances of greater than 5 acres of land located in attainment areas
• Air Pollutant Emission Notices (APEN), Construction Permits and Fees, Operating Permits, and Including the Prevention of Significant Deterioration - APEN Requirements	CAQCC Reg No 3 [5 CCR 1001-5] Part A, Section II	C	An APEN shall be filed with the CDPHE prior to construction, modification or alteration of, or allowing emissions of air pollutants from any activity Certain activities are exempted from APEN requirements per specific exemptions listed in the regulation
- Construction Permits, Including Regulations for the Prevention of Significant Deterioration (PSD)	Part B	C	
- Construction Permits	Part B, Section III		Construction permits are not required for CERCLA activities, however, substantive requirements that would normally be associated with construction permits will apply
- Prevention of Significant Deterioration Requirements	Section IV D 3	A, C, L	Also, fuel-fired equipment (generators, compressors, etc) associated with these activities may require permitting Even though CERCLA activities are

A – Action-specific ARAR, C – Chemical Specific ARAR, L – Location-Specific ARAR, TBC – To Be Considered

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REQUIREMENT	CITATION	TYPE	COMMENT
CLEAN AIR ACT (CAA) [42 USC 7401 et. seq.]			
			exempt from construction permit requirements, PSD requirements may apply if emissions of certain pollutants exceed certain threshold limits The requirements include strict emission control requirements, source impact modeling, and pre-construction and post-construction monitoring
NATIONAL EMISSION STANDARDS FOR HAZARDOUS AIR POLLUTANTS • Part A, Subpart A, General Provisions	40 CFR Part 61, Subpart A 5 CCR 1001-10, Part A, Subpart A	C	This subpart details the general provisions that apply to sources subject to National Emission Standards for Hazardous Air Pollutants (NESHAPs)
• National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities - Standard	40 CFR 61, Subpart H 5 CCR 1001-10, Subpart H 61 92	C, L	This section establishes a radionuclide emission standard equal to those emissions that yield an effective dose equivalent (EDE) of 10 mrem/year to any member of the public The Site complies by using

A – Action-specific ARAR, C – Chemical Specific ARAR, L – Location-Specific ARAR, TBC – To Be Considered

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REQUIREMENT	CITATION	TYPE	COMMENT
CLEAN AIR ACT (CAA) [42 USC 7401 et. seq.]			
			stack effluent discharge data and empirically estimated CAP88-PC for calculating the EDE to the most impacted member of the public to ensure that it does nor exceed 10 mrem/year Also, the perimeter samplers in the Radioactive Ambient Air Monitoring Program sampler network are utilized to verify compliance with the standard
- Emission Monitoring and Test Procedures	61 93	C, A	This section establishes emission monitoring and testing protocols required to measure radionuclide emissions and calculate EDEs This section also requires that radionuclide emissions measurements (stack monitoring) be made at all release points which have a potential to discharge radionuclides into the air which could cause an EDE to the most impacted member of the public in excess of 1% of the standard (0 1 millirem/year)
– Compliance and Reporting	61 96	C, L	This section requires the Site to perform radionuclide air emission assessments of all new and modified

A – Action-specific ARAR, C – Chemical Specific ARAR, L – Location-Specific ARAR, TBC – To Be Considered

REQUIREMENT	CITATION	TYPE	COMMENT
CLEAN AIR ACT (CAA) [42 USC 7401 et. seq.]			
			sources For sources that exceed the 0 1 mrem/year EDE threshold (controlled), the appropriate applications for approval must be submitted to the EPA and the CDPHE Additional substantive requirements may apply if the activity requires approval Substantive air quality requirements would be an ARAR for Alternatives 2, 3, and 4

REQUIREMENT	CITATION	TYPE	COMMENT
FEDERAL WATER POLLUTION CONTROL ACT (aka Clean Water Act [CWA])WATER POLLUTION CONTROL ACT (aka Clean Water Act (CWA)) [33 USC 1251 et. seq.]			
COLORADO BASIC STANDARDS AND METHODOLOGIES FOR SURFACE WATERBASIC STANDARDS AND METHODOLOGIES FOR SURFACE WATER	5 CCR 1002-31	C	See section _ for the list of surface water COCs' action levels and standards The action levels and standards are from RFCA Attachment 5
COLORADO BASIC STANDARDS FOR	5 CCR 1002-41	C	See section _ for the list of ground

A – Action-specific ARAR, C – Chemical Specific ARAR, L – Location-Specific ARAR, TBC – To Be Considered

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REQUIREMENT	CITATION	TYPE	COMMENT
FEDERAL WATER POLLUTION CONTROL ACT (aka Clean Water Act [CWA])WATER POLLUTION CONTROL ACT (aka Clean Water Act (CWA)) [33 USC 1251 et. seq.]			
GROUNDWATERBASIC STANDARDS FOR GROUND WATER			water COCs' action levels The action levels are from RFCA Attachment 5
DOE COMPLIANCE WITH FLOODPLAIN/WETLANDS ENVIRONMENTAL REVIEW REQUIREMENTS • Floodplain/Wetlands Determination • Floodplain/Wetlands Assessment • Applicant Responsibilities	10 CFR 1022 11 12 13	A/L	Substantive wetlands requirements would be an ARAR

REQUIREMENT	CITATION	TYPE	COMMENT
NATURAL RESOURCE AND WILDLIFE PROTECTION LAWSRESOURCE AND WILDLIFE PROTECTION LAWS			
ENDANGERED SPECIES ACT (ESA)SPECIES ACT (ESA) [16 USC 1531 et seq.]			
EARLY CONSULTATION	50 CFR 402 11	A/L	Identify and minimize early in the planning stage of an action, any potential conflicts between the action and federally listed species

A – Action-specific ARAR, C – Chemical Specific ARAR, L – Location-Specific ARAR, TBC – To Be Considered

REQUIREMENT	CITATION	TYPE	COMMENT
NATURAL RESOURCE AND WILDLIFE PROTECTION LAWSRESOURCE AND WILDLIFE PROTECTION LAWS			
BIOLOGICAL ASSESSMENT • Purpose • Preparation Requirements • Request for Information • Director's Response - No Listed Species or Critical Habitat Present - Listed Species or Critical Habitat Present • Verification of Current Accuracy of Species List • Contents • Identical/Similar to Previous Action • Permit Requirements • Completion Time • Submission of Biological Assessment • Use of Biological Assessment	50 CFR 402 12	A/L	This is the process DOE needs to follow to evaluate the potential effects of the action on listed and proposed species and designated and proposed critical habitat and determine whether any such species or habitat are likely to be adversely affected by the action and is used in determining whether formal consultation or a conference is necessary
INTERAGENCY COOPERATION • Informal Consultation • Formal Consultation	50 CFR 402 13 14	A/L	This is an optional process that includes all discussions, correspondence, etc between the USFWS and the DOE It is designed to assist in determining whether formal consultation or a conference is required If during this step it is determined by the DOE with the written concurrence of the USFWS

A – Action-specific ARAR, C – Chemical Specific ARAR, L – Location-Specific ARAR, TBC – To Be Considered

REQUIREMENT	CITATION	TYPE	COMMENT
NATURAL RESOURCE AND WILDLIFE PROTECTION LAWSRESOURCE AND WILDLIFE PROTECTION LAWS			
			that the action is not likely to adversely affect listed species or critical habitat, the consultation process is terminated and no further action is necessary DOE shall review its actions at the earliest possible time to determine whether any action may affect listed species or critical habitat

MIGRATORY BIRD TREATY [16 USC 701-715]			
TAKING, POSSESSION, TRANSPORTATION, SALE, PURCHASE, BARTER, EXPORTATION, AND IMPORTATION OF WILDLIFE AND PLANTS	50 CFR 10	A/L	Principally focuses on the taking and possession of birds protected under this regulation Enforcement is predicated on location of the project and time of the year Current list of protected birds is kept with the Ecology group

REQUIREMENT	CITATION	TYPE	COMMENT
FEDERAL SOLID WASTE DISPOSAL ACT, 42 USC § 6901 *et seq.* (SWDA) & State of Colorado Regulations Pertaining to Solid Waste Disposal Sites & Facilities (6 CCR 1007-2) by reference			
CRITERIA FOR CLASSIFICATION OF SOLID WASTE DISPOSAL FACILITIES AND PRACTICES Scope and purpose	40 CFR PART 257, Subpart A 1 (a)	L, A	The Original Landfill meets the definition of a solid waste disposal facility landfill pursuant to Part 257 The criteria in Part 257, Subpart A,

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REQUIREMENT	CITATION	TYPE	COMMENT
Criteria for classification of solid waste disposal facilities and practices	3	L, A	were adopted for determining which solid waste disposal facilities are considered prohibited "open dumps" under the Resource Conservation and Recovery Act amendments to the SWDA
Floodplains	3-1 (a)	L, A	
Endangered species	3-2 (a), (b)	L, A	
Surface water	3-3 (a), (b), (c)	L,A	The proposed actions to be implemented under this IM/IRA address and meet Part 257 substantive standards and criteria identified in this ARARs table By meeting these criteria the Original Landfill will not pose a reasonable probability of adverse effects and will be a considered an allowed "Sanitary Landfill" under Part 257
Ground water	3-4 (a), (b)(1&2)	L,A, C	
Air	3-7 (a), (b)	L,A	
Safety	3-8 (a), (b), (d)	L,A, C	
CRITERIA FOR MUNICIPAL SOLID WASTE LANDFILLS	40 CFR PART 258 Subpart B – Location restrictions		Part 258 addresses, among other things, closure and post closure requirements for "new or existing" Municipal Solid Waste Landfill Facilities (MSWLFs) Part 258 was promulgated to establish minimum national standards to ensure protection of human health and the environment
Fault areas	13 (a)	L, A	
Seismic impact zones	14 (a)	L, A	
	15 (a)	L, A	

A – Action-specific ARAR, C – Chemical Specific ARAR, L – Location-Specific ARAR, TBC – To Be Considered

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REQUIREMENT	CITATION	TYPE	COMMENT
Unstable areas	Subpart C – Operating Criteria		The Original Landfill does not meet the Part 258 definition of an "existing or new" MSWLF because it did not receive solid waste after October 9,
	26 (a)	A	1991
Run-on/run-off control systems	27 (a)	A	However, the Part 258 regulations listed in this ARARs Table regarding
Surface water requirements	Subpart E – Ground Water Monitoring and Corrective Action		location restrictions, operating criteria, ground water monitoring, and closure and post closure care are not addressed in Part 257 The proposed
	50 (f)	A	actions to be implemented under this IM/IRA address and meet the Part 258
Applicability	51 (a), (c), (d)	L, A	substantive standards and criteria identified in this ARARs table
Ground water-monitoring systems	53 (a), (b), (c), (e), (f), (g), (h), (i)	L, A, C	Part 257 3-4 does not actually specify that ground water must be analyzed
Ground-water sampling and analysis requirements	54 (a), (b), (c) (2&3)	C	Rather, the landfill must not contaminate an underground drinking
Detection monitoring program	55 (a), (b), (c), (d) (2), (e), (f), (g), (h), (i), (j)	A, C	water source above maximum contaminant levels for those constituents listed in Part 257
Assessment monitoring program	Subpart F -- Closure and Post-Closure Care		Appendix I There is no underground water drinking water source in the landfill area so monitoring will not be
	60 (a)	A	performed for the Part 257 Appendix I constituents Part 258 ground water

A – Action-specific ARAR, C – Chemical Specific ARAR, L – Location-Specific ARAR, TBC – To Be Considered

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REQUIREMENT	CITATION	TYPE	COMMENT
Closure criteria Post-closure care requirements	61 (a), (b), (c) (3)	A	sampling requirements will be implemented and the analytes selected from Part 258 Appendix 1, as specified in section 258 54 (a)

A – Action-specific ARAR, C – Chemical Specific ARAR, L – Location-Specific ARAR, TBC – To Be Considered

Appendix B

Wetland Mitigation Plan

Appendix C

Comment Response Summary

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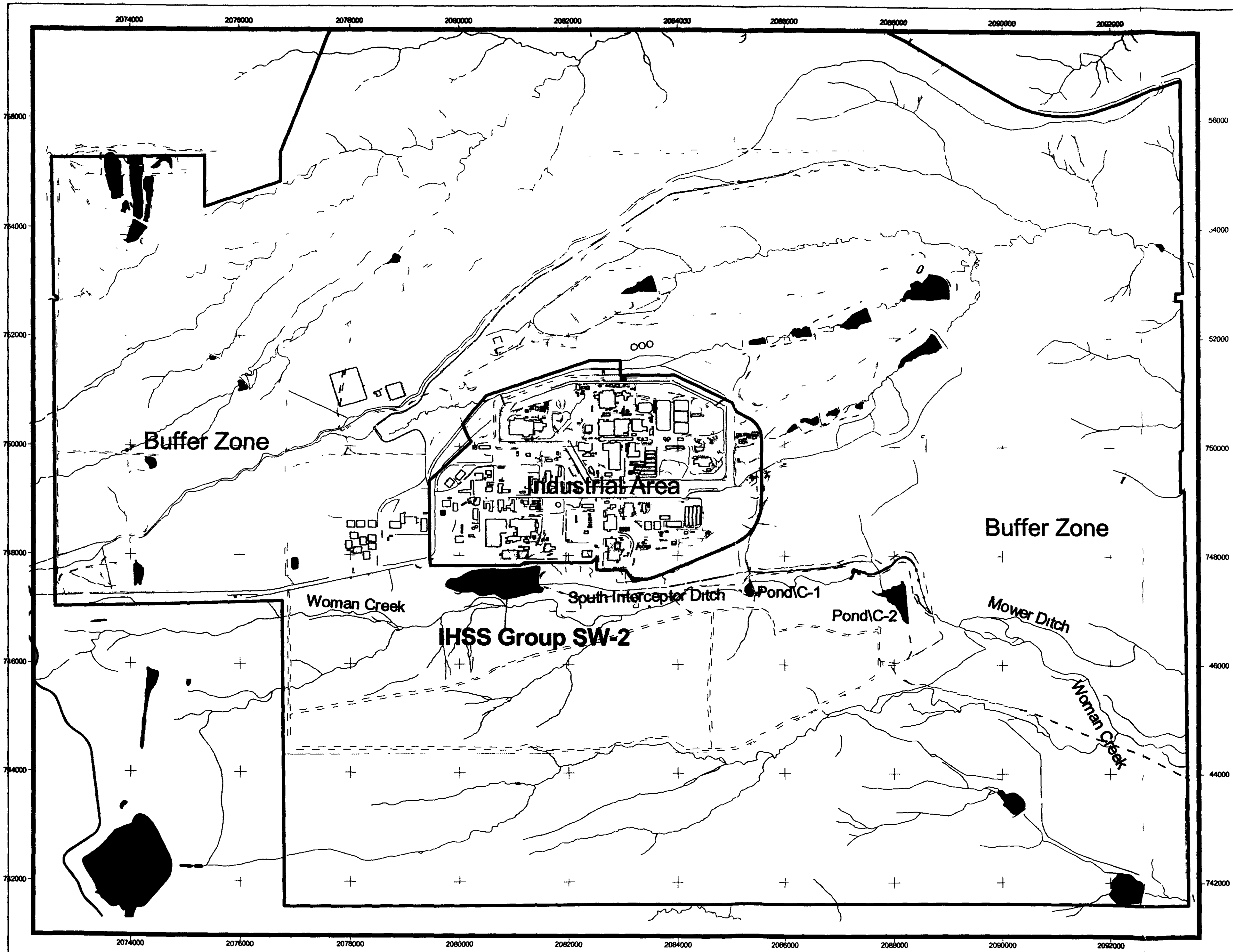

Figure 1-1
IHSS Group SW 2
Location Map

KEY

- IHSS Group SW 2
- Building
- Stream ditch or drainage
- Paved area
- Dirt road
- Fence

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Prepared by

RADMS

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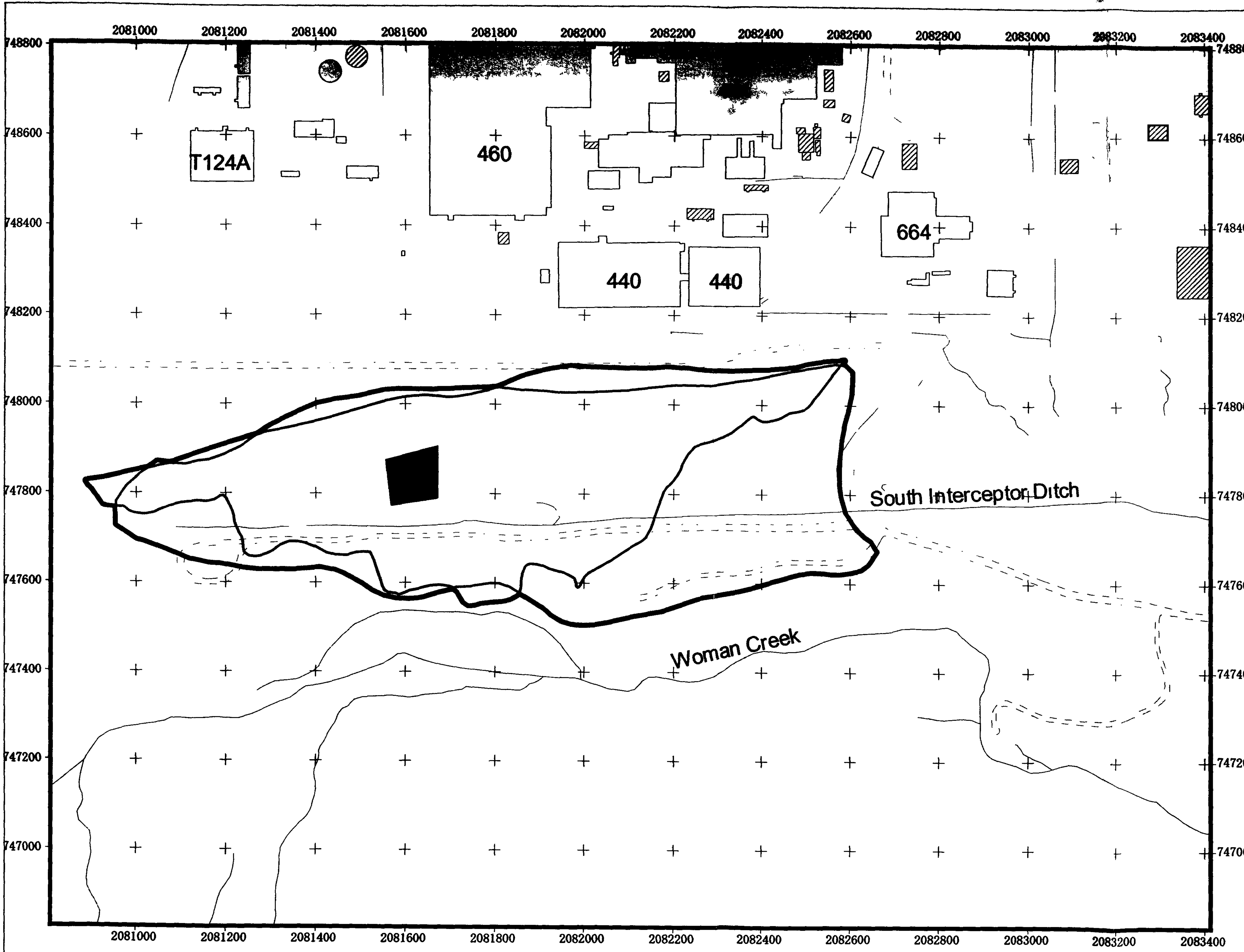

Figure 1-2
Location of IHSS 115 and IHSS 196

KEY

- Waste material boundary
- IHSS SW 115
- Original Landfill Area of Concern
- IHSS SW 196
- Standing building
- Demolished building
- Streams
- Paved area
- Dirt road
- Fence

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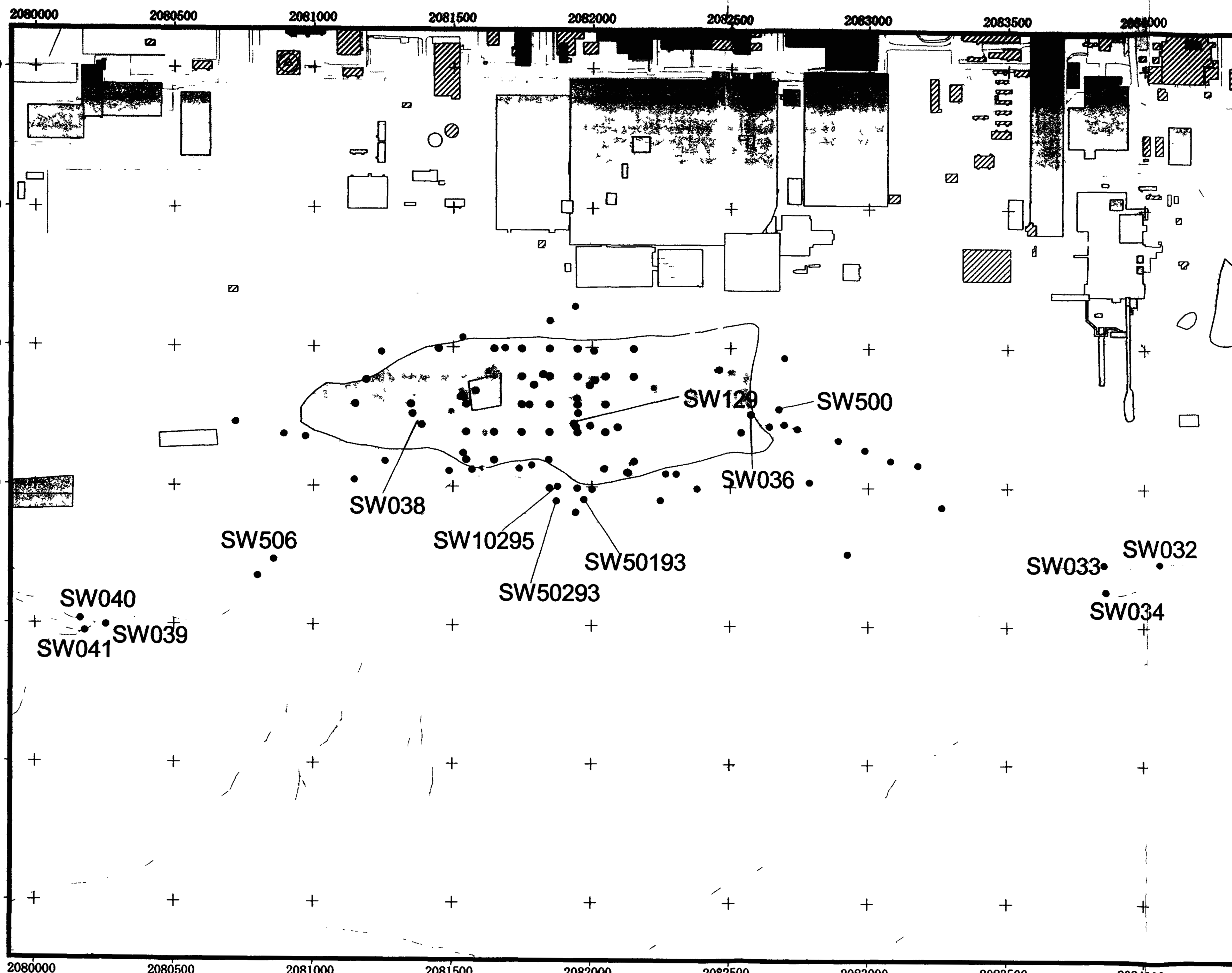

Figure 4-1
Sampling Locations

KEY

- Surface Soil Sampling Location
- Subsurface Soil Sampling Location
- Groundwater Sampling Location
- Surface Water Sampling Location

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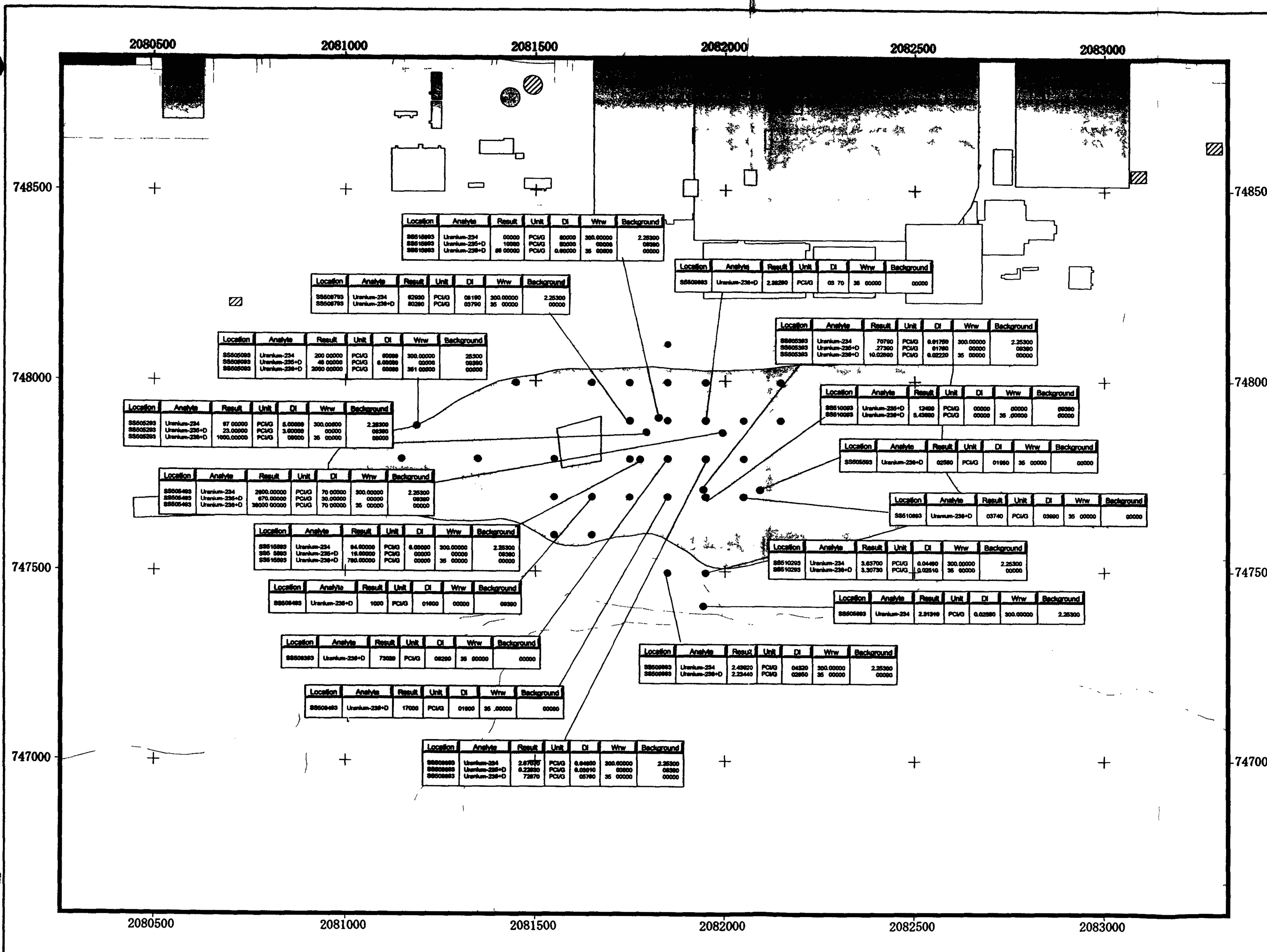

Figure 4-2
Uranium Concentrations in Surface Soil

KEY

- Concentration Exceeded a Wildlife Refuge Worker (WRW) Action Level (AL)
- Concentration > Background Means Plus 2 Standard Deviations But < WRW AL
- All Other Surface Soil Sampling Locations

IHSS

Paved Road

Dirt Road

Streams

Demolished Building

Standing Building

Dl -- detection limit

ORIGINAL LANDFILL IM/IRA PLAN

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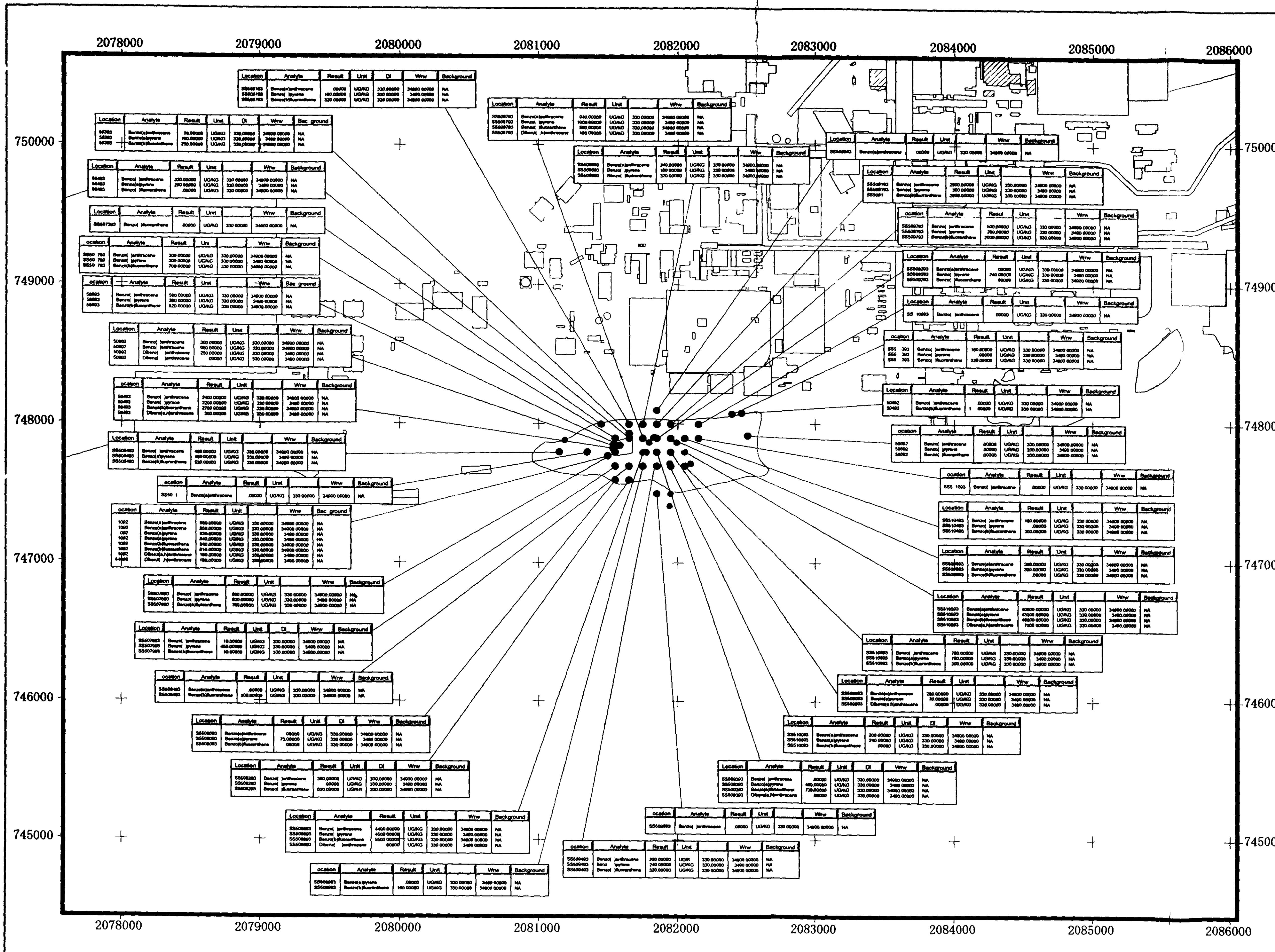

Figure 4-3
Polynuclear Aromatic Hydrocarbon Concentrations in Surface Soil

KEY

- Sample in which a Concentration Exceeded a Wildlife Refuge Worker (WRW) Action Level (AL)
- Concentration > Detection Limit but < WRW AL
- All Other Surface Soil Sampling Locations

IHSS

Paved Roads

Dirt Roads

Streams

Demolished Building

Standing Building

Dl – detection limit

ORIGINAL LANDFILL IM/IRA PLAN

200 0 200 400 600 800 1000 Feet

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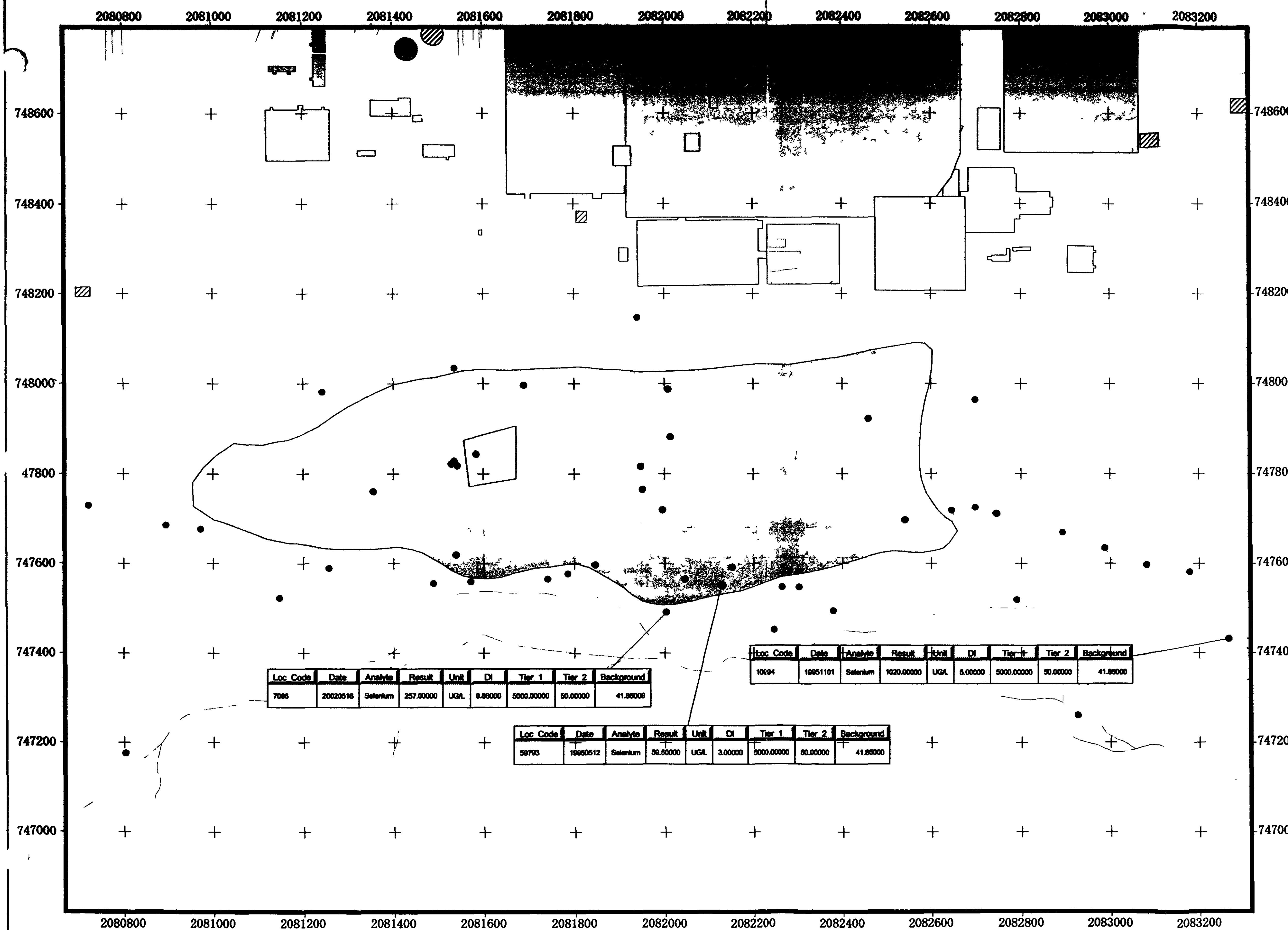

Figure 4-5
Maximum Selenium Concentrations in Groundwater

KEY

- Concentration > Tier II Action Level
- All Other Groundwater Sampling Locations (Below Background Concentrations)
- IHSS
- Paved Roads
- Dirt Roads
- Streams
- Demolished Building
- Standing Building

Dl -- detection limit

ORIGINAL LANDFILL IM/IRA PLAN

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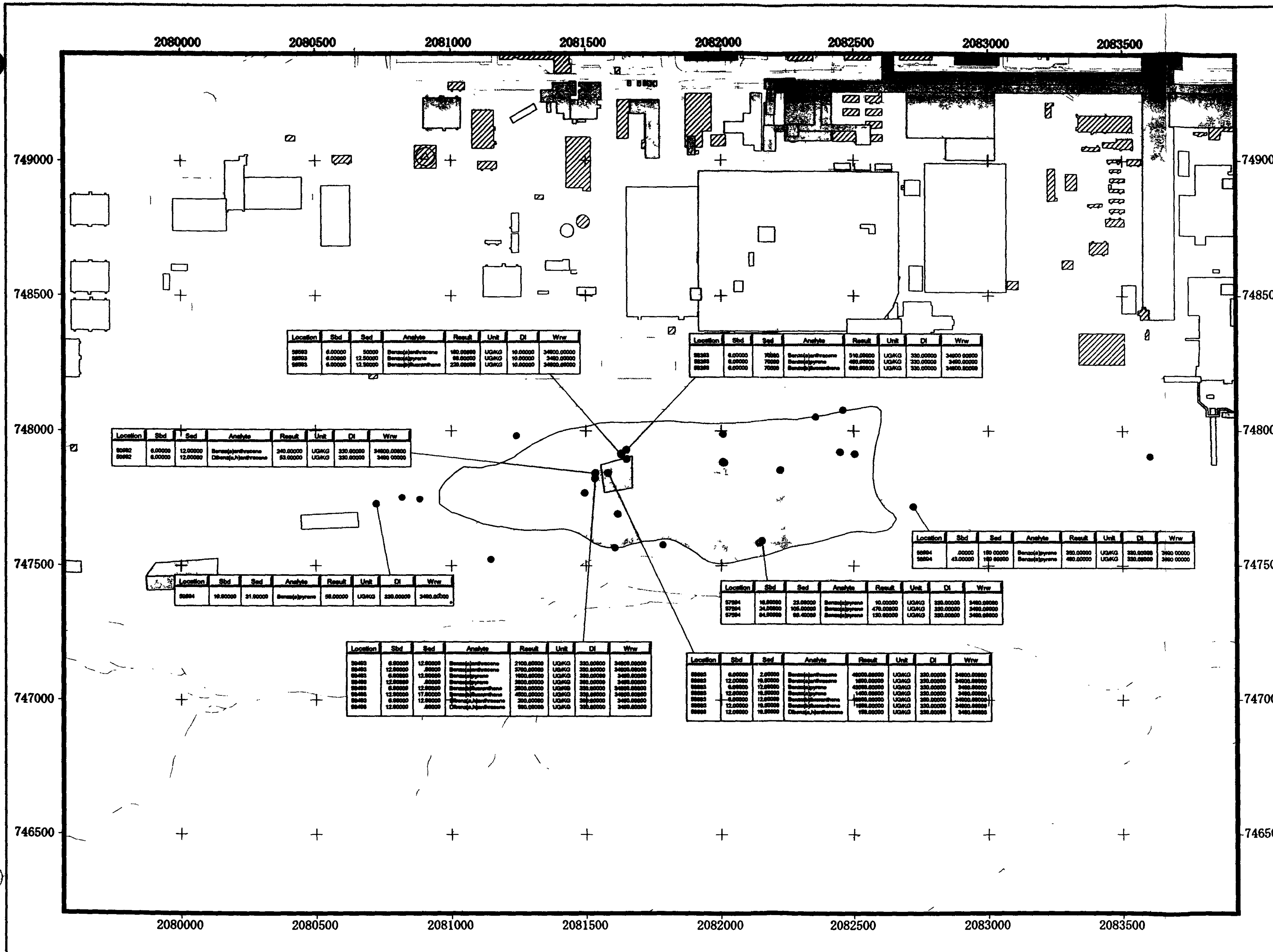

Figure 4-4
Polynuclear Aromatic Hydrocarbon Concentrations in Subsurface Soil

KEY

- Concentration > Wildlife Refuge Worker (WRW) Action Level (AL)
- Concentration > Detection Limit But < WRW AL
- All Other Subsurface Soil Sampling Locations

IHSS

Paved Road

Dirt Road

Streams

Demolished Building

Standing Building

Dl – Detection Limit

ORIGINAL LANDFILL IM/IRA PLAN

200 0 200 400 Feet

Scale = 1 4,250

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Prepared for: KAISER•HILL COMPANY

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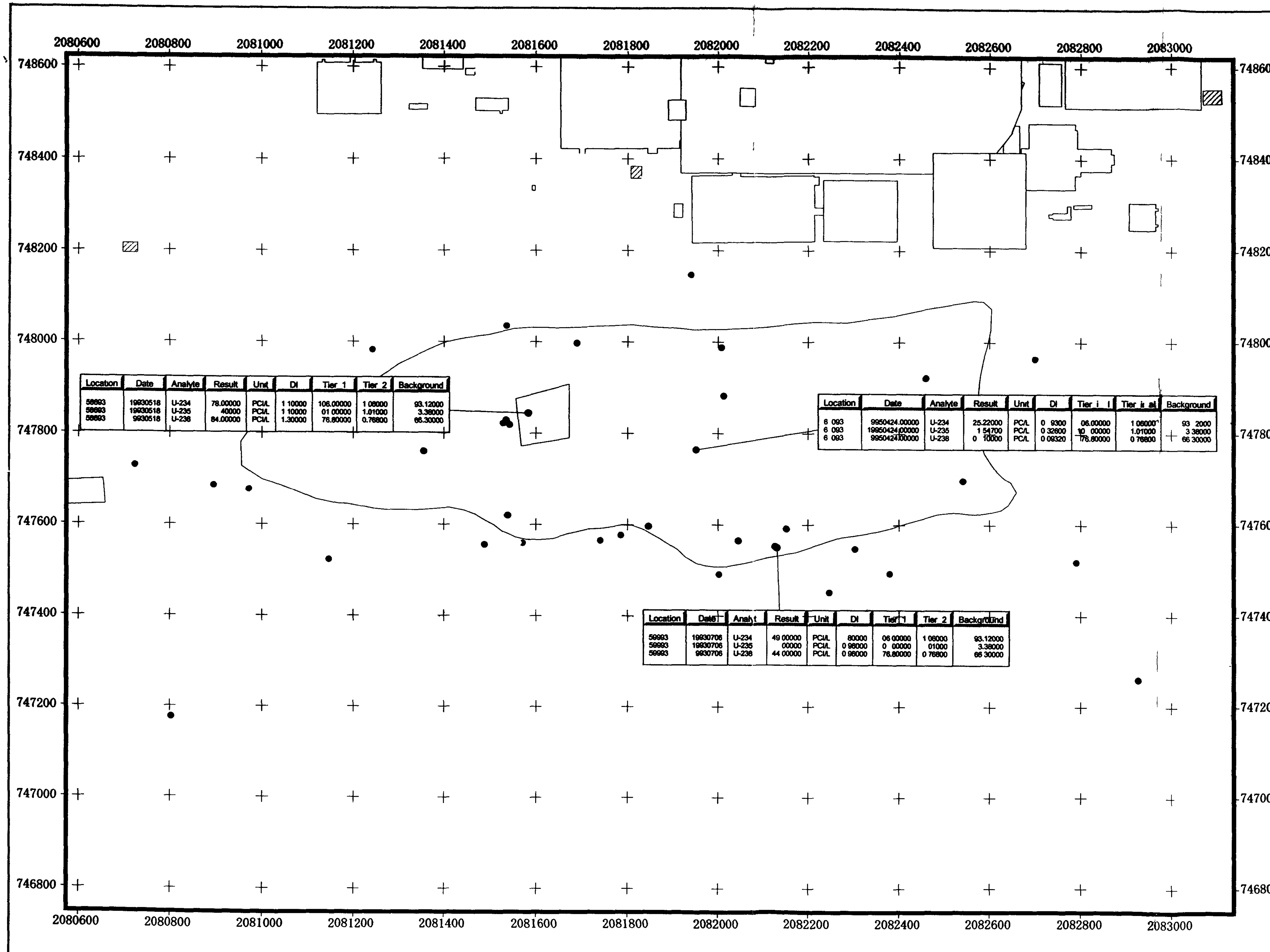

Location	Date	Analyte	Result	Unit	Dl	Tier 1	Tier 2	Background
58693	19930518	U-234	78.00000	PCi/L	1 10000	106.00000	1 06000	93.12000
58693	19930518	U-235	40000	PCi/L	1 10000	01 00000	1.01000	3.38000
58693	9930518	U-238	84.00000	PCi/L	1.30000	76.80000	0.76800	66.30000

Location	Date	Analyte	Result	Unit	Dl	Tier i l	Tier ii al	Background
6 093	9950424.00000	U-234	25.22000	PC/L	0 9300	06.00000	1 06000	93 2000
6 093	19950424.00000	U-235	1 54700	PC/L	0 32600	10 00000	1.01000	3 38000
6 093	9950424.00000	U-238	0 10000	PC/L	0 09320	76.80000	0 76800	66 30000

Location	Date	Analyt	Result	Unit	Dl	Tier 1	Tier 2	Background
59993	19930706	U-234	49 00000	PCi/L	80000	06 00000	1 06000	93.12000
59993	19930706	U-235	00000	PCi/L	0 96000	0 00000	01000	3.38000
59993	9930706	U-238	44 00000	PCi/L	0 96000	76.80000	0 76800	66 30000

Figure 4-8
Maximum Uranium Concentrations in Groundwater

KEY

- Concentration Exceeded a Tier I Groundwater Action Level
- Concentration Exceeded Background Mean Plus 2 Standard Deviations
- All Other Groundwater Wells Sampled
- IHSS
- Paved Road
- Dirt Road
- Streams
- Demolished Building
- Standing Building

Dl – detection limit

ORIGINAL LANDFILL IM/IRA PLAN

W

100 0 100 200 Feet

Scale ~ 1 2 500

State Plane Coordinate Projection
Colorado Central Zone
Datum NAD 27

U S Department of Energy
Rocky Flats Environmental Technology Site

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RADMS

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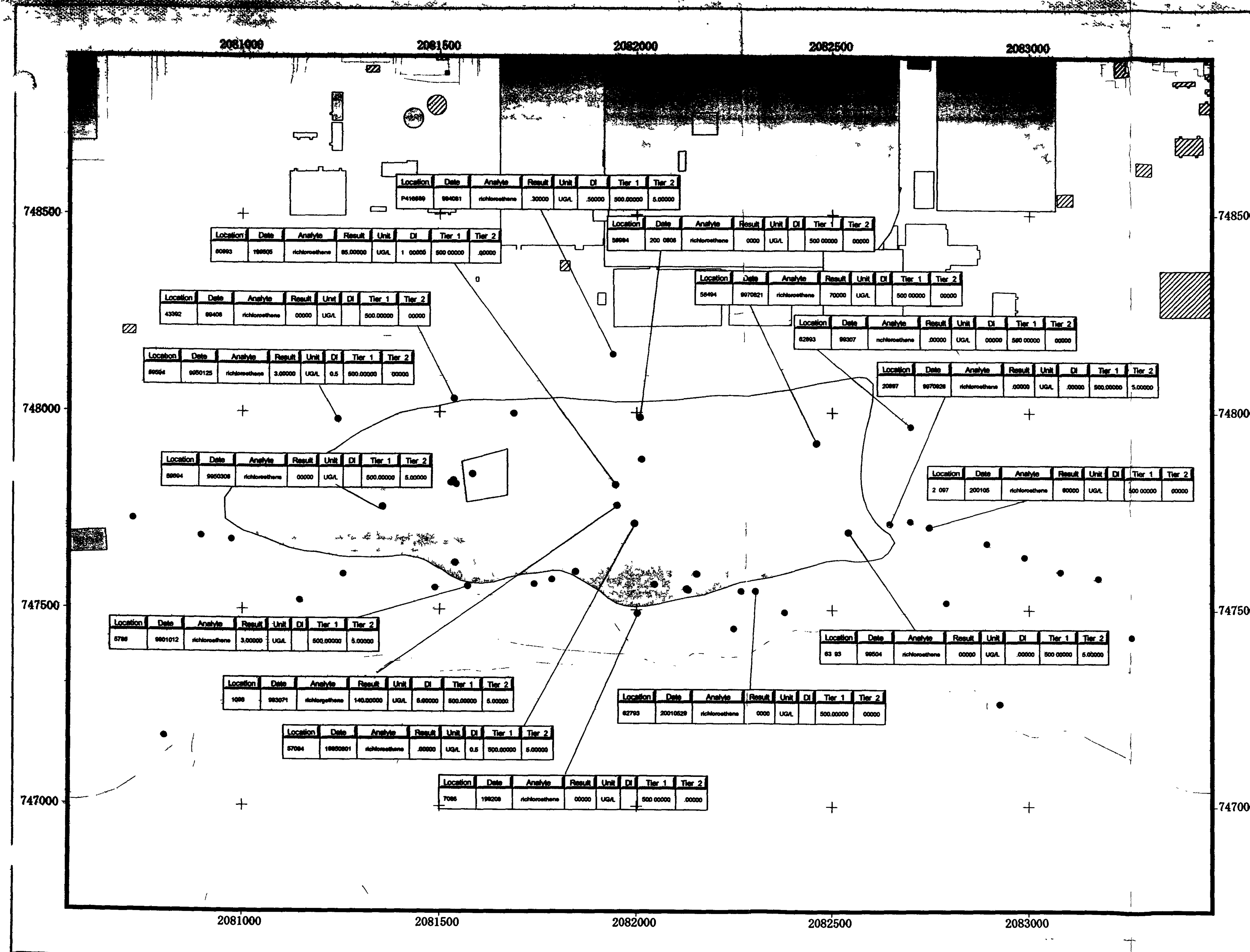
Figure 4.10
Maximum Trichloroethene Concentrations in Groundwater



Location	Date	Analyte	Result	Unit	DI	Tier 1	Tier 2
P416689	994081	richloroethene	.30000	UG/L	.50000	500.00000	5.00000
60993	199505	richloroethene	85.00000	UG/L	1 00000	500 00000	.00000
58994	200 0806	richloroethene	0000	UG/L		500 00000	00000
58494	9970821	richloroethene	70000	UG/L		500 00000	00000
43392	99408	richloroethene	00000	UG/L		500.00000	00000
62893	99307	richloroethene	.00000	UG/L	00000	500 00000	00000
59594	9950125	richloroethene	3.00000	UG/L	0.5	500.00000	00000
20897	9970928	richloroethene	.00000	UG/L	.00000	500.00000	5.00000
59894	9950308	richloroethene	00000	UG/L		500.00000	5.00000
2 097	200105	richloroethene	60000	UG/L		500 00000	00000
5786	9901012	richloroethene	3.00000	UG/L		500.00000	5.00000
63 93	99504	richloroethene	00000	UG/L	.00000	500 00000	5.00000
1086	993071	richlorgethene	140.00000	UG/L	5.00000	500.00000	5.00000
62793	20010529	richloroethene	0000	UG/L		500.00000	00000
57094	19980801	richloroethene	.00000	UG/L	0.5	500.00000	5.00000
7086	199208	richloroethene	00000	UG/L		500 00000	.00000

KEY

- Concentration > Tier II Action Level
- Concentration < Tier II Action Level
- All Other Groundwater Sampling Locations
- IHSS
- Paved Road
- Dirt Roads
- Streams
- Demolished Building
- Standing Building

DI = Detection Limit

ORIGINAL LANDFILL IM/IRA PLAN

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W E S

200 0 200 Feet

Scale = 1 2 750

State Plane Coordinate Projection
Colorado Central Zone
Datum NAD 27

U S Department of Energy
Rocky Flats Environmental Technology Site

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Date 07/10/03

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